



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

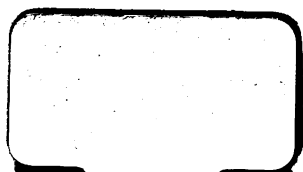
- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>



3 3433 07597126 1



103G/

Institution

EPH

PROCEEDINGS
OF THE
ASSOCIATION OF MUNICIPAL AND SANITARY
ENGINEERS AND SURVEYORS.

VOLUME VII.—1880-81.

EDITED BY
THOMAS COLE,
ASSOC. M.I.C.E.,
(Secretary of the Association).

*This Association is not as a body responsible for the facts and opinions
advanced herein.*

LONDON:
E. & F. N. SPON, 16, CHARING CROSS.
NEW YORK:
446, BROOME STREET.
1881.

1875-

LONDON:
PRINTED BY WILLIAM CLOWES AND SONS, LIMITED,
STAMFORD STREET AND CHARING CROSS.

CONTENTS.

| | PAGE |
|--|------|
| LIST OF OFFICERS | v |
| LIST OF MEMBERS | vi |
| LIST OF TOWNS REPRESENTED | xii |
| RULES | xvii |
| ANNUAL REPORT AND FINANCIAL STATEMENT FOR YEAR ENDING APRIL | |
| 30TH, 1881 | 1 |
| ALTERATION OF RULES III. AND V. | 3 |
| APPOINTMENT OF AUDITORS | 3 |
| " " SCRUTINEERS | 4 |
| DISTRICT MEETINGS— | |
| MEETING AT DARLINGTON : | |
| Election of P. W. Thomson, C.E., as Hon. Secretary for the Northern District | 6 |
| Disposal of the Sewage at Shildon. J. Craggs, C.E. | 8 |
| Discussion on ditto | 10 |
| Sanitary Appliances. Geo. Bell, C.E. | 14 |
| Discussion on ditto | 16 |
| Visits to Works | 20 |
| MEETING AT SALFORD : | |
| Re-election of R. Vawser, M. Inst. C.E., as Hon. Secretary for Lancashire and Cheshire District | 21 |
| Visit to the Salford Sewage Works | 21 |
| Visit to the Health Committee's Depôt at Holt Town, Manchester | 22 |
| MEETING AT BLAYDON-ON-TYNE : | |
| Discussion on Location of Secretary | 25 |
| Roadways. Jas. Hall, C.E. | 26 |
| Discussion on ditto | 40 |
| Wood Pavements. R. S. Rounthwaite, C.E. | 48 |
| Discussion on ditto | 53 |
| Visits to Works | 57 |

| | PAGE |
|---|------|
| MEETING AT HANLEY: | |
| Re-election of E. Pritchard, C.E., as Hon. Secretary of the Midland District | 58 |
| Visits to Works | 58 |
| The Hanley Sewage Works. J. Loble, Assoc. M. Inst. C.E. .. | 58 |
| Discussion on ditto | 67 |
| MEETING AT BARNLEY: | |
| Re-election of B. C. Cross, C.E., as Hon. Secretary for the Yorkshire District | 74 |
| The Barnley Sewage Works. J. H. Taylor, Assoc. M. Inst. C.E. | 74 |
| Discussion on ditto | 78 |
| Visit to Works | 78 |
| ANNUAL MEETING AT BIRMINGHAM: | |
| Address of the President | 79 |
| Discussion on the Birmingham Sewage Works | 88 |
| Sanitary Supervision of Dwellings. L. Angell, M. Inst. C.E. .. | 106 |
| Discussion on ditto | 116 |
| The Rivers Conservancy and Floods Prevention Bill. R. Vawser, M. Inst. C.E. | 128 |
| Discussion on ditto | 132 |
| Steam Road Rolling. E. Buckham, Assoc. M. Inst. C.E. | 138 |
| Visits to Works, &c. | 140 |
| MEMOIRS OF DECEASED MEMBERS: James Craggs; J. Galsworthy; Alfred William Morant; E. L. Stephens.. .. . | |
| | 145 |

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.

LIST OF OFFICERS, 1881-2.

COUNCIL.

President.

W. S. TILL, M. INST. C.E., BOROUGH ENGINEER, BIRMINGHAM.

Past Presidents.

LEWIS ANGELL, M. INST. C.E., LONDON.
J. G. LYNDE, M. INST. C.E., MANCHESTER.
JAMES LEMON, M. INST. C.E., SOUTHAMPTON.
F. ASHMEAD, M. INST. C.E., BOROUGH ENGINEER, BRISTOL.
G. F. DEACON, M. INST. C.E., WATER ENGINEER, LIVERPOOL.
E. PRITCHARD, C.E., BIRMINGHAM AND LONDON.

Vice-Presidents.

J. ALLISON, ASSOC. M. INST. C.E., CITY SURVEYOR, MANCHESTER.
C. DUNSCOMBE, M.A., ASSOC. M. INST. C.E., CITY ENGINEER, LIVERPOOL.
R. VAWSER, M. INST. C.E., 17, COOPER STREET, MANCHESTER.

Ordinary Members of Council.

H. ALTY, C.E., BOROUGH SURVEYOR, PLYMOUTH.
H. P. BOULNOIS, M. INST. C.E., CITY SURVEYOR, EXETER.
W. B. BRYAN, M. INST. C.E., BOROUGH ENGINEER, BLACKBURN.
R. DAVIDSON, ASSOC. M. INST. C.E., BOROUGH ENGINEER, SHEFFIELD.
A. M. FOWLER, M. INST. C.E., BOROUGH ENGINEER, NEWCASTLE-ON-TYNE.
S. HARPUR, ASSOC. M. INST. C.E., SURVEYOR TO THE LOCAL BOARD, MERTHYR TYDFIL.
T. HEWSON, M. INST. C.E., BOROUGH SURVEYOR, ROCHDALE.
J. LOBLEY, ASSOC. M. INST. C.E., BOROUGH ENGINEER, HANLEY.
A. W. PARRY, ASSOC. M. INST. C.E., BOROUGH ENGINEER, READING.
J. PROCTOR, M. INST. C.E., BOROUGH ENGINEER, BOLTON.
T. C. THORBURN, C.E., BOROUGH ENGINEER, BIRKENHEAD.
W. H. WHITE, M. INST. C.E., CITY SURVEYOR, OXFORD.

District Honorary Secretaries.

HOME COUNTIES DISTRICT.—E. B. ELLICE-CLARK, ASSOC. M. INST. C.E., 4, WESTMINSTER CHAMBERS, S.W.
MIDLAND COUNTIES DISTRICT.—E. PRITCHARD, C.E., BIRMINGHAM.
YORKSHIRE DISTRICT.—B. C. CROSS, C.E., DEWSBURY.
LANCASHIRE AND CHESHIRE DISTRICT.—R. VAWSER, M. INST. C.E., 17, COOPER STREET, MANCHESTER.
WESTERN DISTRICT.—H. P. BOULNOIS, M. INST. C.E., EXETER.
NORTHERN DISTRICT.—P. W. THOMSON, C.E., WILLINGTON QUAY, NORTHUMBERLAND.

General Honorary Secretary.

C. JONES, ASSOC. INST. C.E., EALING, W.

Treasurer.

LEWIS ANGELL, M. INST. C.E., LONDON.

Secretary.

THOMAS COLE, ASSOC. M. INST. C.E., 6, WESTMINSTER CHAMBERS, LONDON, S.W.

HONORARY MEMBERS.

| | |
|--|------------------------------------|
| BAZALGETTE, SIR JOSEPH, C.B., | Metropolitan Board of Works. |
| M. Inst. C.E. | |
| HARRISON, J. T., M. Inst. C.E. | Local Government Board, Whitehall. |
| HAYWOOD, W., M. Inst. C.E. | Guildhall, City of London. |
| RAWLINSON, R., C.B., M. Inst. C.E. .. | Local Government Board, Whitehall. |
| TULLOCH, MAJOR H., R.E., Assoc. Inst. C.E. | Local Government Board, Whitehall. |

MEMBERS.

| | |
|--|--|
| ALLEN, T. T. | Borough Surveyor, Stratford-upon-Avon. |
| ALLIES, E. H., Assoc. M. Inst. C.E. | Surveyor to the Local Board, West Derby, Liverpool. |
| ALLISON, J., Assoc. M. Inst. C.E. (<i>Vice-President</i> .) | City Surveyor, Manchester. |
| ALLSOPP, JOHN, Assoc. M. Inst. C.E. | Surveyor to the Local Board, Worksop, Nottingham. |
| ALTY, H. (<i>Member of Council</i> .) | Borough Surveyor, Plymouth. |
| ANDREWS, G. R. | Town Hall Chambers, Bournemouth. |
| ANGELL, L., M. Inst. C.E. (<i>Past President and Treasurer</i> .) | Westminster, and West Ham Local Board, Town Hall, Stratford, London, E. |
| ANSOOMB, J. S. | Borough Surveyor, Maidstone, Kent. |
| ARMISTEAD, RICHARD | Surveyor to the Improvement Commissioners, Bingley, Yorkshire. |
| ASHMEAD, F., M. Inst. C.E. (<i>Past President</i> .) | Borough Surveyor, Bristol. |
| ASPINWALL, H. S. | Late Borough Surveyor, Macclesfield; King Edward Street, Macclesfield. |
| BAKER, B. | Surveyor to the Local Board, Willenhall, Staffordshire. |
| BANKS, W. | City Surveyor, Rochester. |
| BATTEN, W. Assoc. M. Inst. C.E. | Late Local Board Surveyor to the Manor of Aston, Warwickshire; 150, Lozells Road, Handsworth, near Birmingham. |
| BAYLIS, T. W. | Surveyor to the Local Board, Redditch. |
| BEAUMONT, J. | Late Borough Surveyor, Beverley. |
| BELL, G. | Surveyor to the Local Board, Felling, Newcastle-on-Tyne. |
| BIDDLE, G. | Borough Surveyor, Bootle-cum-Linaacre, Lancashire. |
| BLACKSHAW, W. | Borough Surveyor, Congleton, Cheshire. |
| BOULNOIS, H. P., M. Inst. C.E. (<i>Member of Council</i> .) | City Surveyor, Exeter; <i>Hon. Secretary</i> Western District. |
| BOWER, Jas., M. Inst. C.E. .. | Borough Engineer, Gateshead-on-Tyne. |
| BOYS, W. J., Assoc. M. Inst. C.E. | Borough Surveyor, Walsall, Staffordshire. |

| | | |
|---|-------|---|
| BRESSEY, J. T. | .. .. | Surveyor to the Local Board, Wanstead, Essex. |
| BRETHERTON, T. | .. .. | Public Hall, Haslingden. |
| BRIERLEY, R. | .. .. | Town Surveyor, Newton-in-Makerfield, Lancashire. |
| BROUGHTON, THOMAS | .. .. | Borough Surveyor, Warwick. |
| BROWN, JOS. W. | .. .. | Surveyor to the Local Board, Manor of Aston. |
| BRYAN, W. B., M. Inst. C.E. | | Borough and Water Engineer, Blackburn. |
| (Member of Council.) | | |
| BUCKHAM, E., Assoc. M. Inst. C.E. | | Borough Surveyor, Ipswich. |
| BURTON, J. H. | .. .. | Surveyor to the Local Board, Audenshaw, Lancashire. |
| BUTLER, G. J. | .. .. | Borough Surveyor, Shrewsbury, Salop. |
| CARTWRIGHT, J., Assoc. M. Inst. C.E. | | Borough Surveyor, Bury, Lancashire. |
| CHURCHWARD, S. | .. .. | Town Surveyor, St. Thomas, near Exeter. |
| CLARKE, H. F. | .. .. | Surveyor to the Local Board, Briton Ferry, Glamorgan. |
| CLAVEY, E. | .. .. | Borough Surveyor, Burton-upon-Trent. |
| COLE, G., M.S.E., M.S.I. | .. .. | City Surveyor, Hereford. |
| COMBER, A. | .. .. | Borough Surveyor, Kidderminster. |
| COOK, JOHN | .. .. | Surveyor to the Local Board, North Bierley, Yorkshire. |
| COULTHURST, THOS. | .. .. | Borough Surveyor, Derby. |
| COUSINS, EL., M. Inst. C.E. | .. .. | Borough Surveyor, Swansea. |
| COWELL, F. N. | .. .. | Surveyor to the Local Board, Harrow, Middlesex. |
| COX, J. H. | .. .. | Borough Surveyor, Town Hall, Bradford. |
| CRABTREE, W., Assoc. M. Inst. C.E. | | Borough Surveyor, Southport. |
| CREER, A. | .. .. | Surveyor to the Urban Sanitary Authority, Lancaster. |
| CREGEEN, H. S. | .. .. | Surveyor to the Local Board, Bromley, Kent. |
| CROSS, B. C. (Member of Council.) | | Dewsbury, Yorkshire; Hon. Secretary Yorkshire District. |
| CRUSE, T. | .. .. | Surveyor to the Local Board, Warminster, Wiltshire. |
| CURRY, MATHEW, jun., Assoc. M. Inst. C.E. | | Borough Engineer, Dover. |
| CURTIS, J. P. | .. .. | Surveyor to the Local Board, Stapleton, near Bristol. |
| DAVIDSON, R., Assoc. M. Inst. C.E. (Member of Council.) | | Borough Surveyor, Sheffield. |
| DAVIES, R. | .. .. | Borough Surveyor, Brecknock. |
| DAVIS, A. T. | .. .. | Surveyor to the Sanitary Authority, Solihull, Warwickshire. |
| DAVISON, THOS. V. H. | .. .. | Surveyor to the Local Board, Swindon, Wilts. |
| DAWSON, T. | .. .. | Surveyor to the Local Board, Benwell, near Newcastle-on-Tyne. |
| DAWSON, W. | .. .. | Surveyor to the Local Board, St. George, Gloucestershire. |
| DEACON, G. F., M. Inst. C.E. (Past President.) | | Water Engineer, Liverpool. |
| DENT, WILLIAM | .. .. | Surveyor to the Local Board, Nelson-in-Marsden, Lancashire. |
| DEVIS, J. | .. .. | Surveyor to the Local Board, Oldbury, Worcester-shire. |
| DICKENSON, G. | .. .. | Surveyor to the Local Board, Leigh, Lancashire. |
| DITCHAM, H. | .. .. | Borough Surveyor, Harwich. |
| DOWNIE, JOHN S. L. | .. .. | Surveyor to the Local Board, Skelton, Cleveland. |

| | |
|---|---|
| DUNSCOMBE, C., M.A., Assoc. M. Inst. C.E. (<i>Vice-President.</i>) | City Engineer, Liverpool. |
| EARNSHAW, J. T., Assoc. M. Inst. C.E. | Borough Surveyor, Ashton-under-Lyne, Lancashire. |
| EAYRS, J. T. | Borough Surveyor, West Bromwich. |
| ELLIOT-CLARK, E. B., Assoc. M. Inst. C.E. (<i>Member of Council.</i>) | 4, Westminster Chambers, S.W.; <i>Hon. Secretary</i> Home Counties District. |
| ESCOTT, E. R. S. | Borough Engineer, Halifax. |
| FARRAR, J., M. Inst. C.E. | 12, Market Street, Bury. |
| FEREDAY, J. W. | Surveyor to the Local Board, Wednesbury, Staffordshire. |
| FOOTE, A. | Borough Surveyor, Oldham. |
| FOWLER, A. M., M. Inst. C.E. (<i>Member of Council.</i>) | Borough Engineer and Property Surveyor, Newcastle-on-Tyne. |
| FOX, W. H., Assoc. M. Inst. C.E. | Borough Engineer, Town Hall, Barrow-in-Furness. |
| FROST, T. | Town Surveyor, Leek, Staffordshire. |
| GAMBLE, S. G., Assoc. M. Inst. C.E. | Borough Surveyor, Grantham, Lincolnshire. |
| GLEDHILL, T. | Town Surveyor, Heckmondwike, Yorkshire. |
| GOLDSWORTH, W. | Surveyor to the Local Board, Prescott, Lancashire. |
| GOODCHILD, T. | Surveyor to the Local Board, Teddington, Middlesex. |
| GORDON, Jos., M. Inst. C.E. | Borough Surveyor, Leicester. |
| GRAY, W. H. | Borough Surveyor, Tewkesbury, Gloucestershire. |
| HALL, J. A. | Surveyor to the Local Board, Toxteth Park, Liverpool. |
| HALL, J. G., Assoc. M. Inst. C.E. | City Surveyor, Canterbury. |
| HALL, J. | Borough Surveyor, Stockton-on-Tees, Durham. |
| HALL, M. | Borough Surveyor, South Shields, Durham. |
| HALLER, J. C. | Surveyor to the Local Board, Swinton, near Rotherham. |
| HARDING, J. R., Assoc. Inst. C.E. | Surveyor to the Local Board, Epsom, Surrey. |
| HARDWICKE, A., Assoc. Inst. C.E. | Borough Surveyor, Longton, Staffordshire. |
| HARPUR, S., Assoc. M. Inst. C.E. (<i>Member of Council.</i>) | Surveyor to the Local Board, Merthyr Tydfil, Glamorganshire. |
| HARRY, E. W. | Town Surveyor, Harrogate, W. R. Yorkshire. |
| HART, J., Assoc. M. Inst. C.E. | Borough Surveyor, St. Helena, Lancashire. |
| HEAP, W. E. | Surveyor to the Local Board, Norden, near Rochdale. |
| HEWSON, T., M. Inst. C.E. (<i>Member of Council.</i>) | Borough Surveyor, Rochdale. |
| HEYS, JOSEPH | Surveyor to the Local Board, Hurst Brook, Ashton-under-Lyne. |
| HEYWOOD, T. | Surveyor, Barton, Eccles, Winton, and Monton, Patricroft, near Manchester. |
| HILDRED, D. | Borough Surveyor, Batley, Yorkshire. |
| HODGE, R. | Late Borough Surveyor, Plymouth. |
| HOLMES, J. | Surveyor to the Local Board, Selby, Yorkshire. |
| HOLT, THOMAS | Surveyor to the Local Board, Whitworth, near Rochdale. |
| HOOPER, J. D. | Surveyor to the Local Board, Woodford, Essex. |
| HORNIBROOK, J. H. C. B. | Borough Surveyor, Reigate, Surrey. |

| | |
|--|---|
| HOWARD, W. F., Assoc. M. Inst. C.E. | 13, Cavendish Street, Chesterfield. |
| HOWBOFT, JAMES | Surveyor to the Local Board, Kirkleatham, Yorkshire. |
| HUGHES, ROBT. | Town Surveyor, Rhyl, Flintshire. |
| INCH, R. H., Assoc. M. Inst. C.E. | Town Surveyor, Lowestoft, Suffolk. |
| JENNINGS, G. | Borough Surveyor, Danesford, Nelson Street, Rotherham. |
| JEPSON, W. M., Assoc. M. Inst. C.E. | Surveyor to the Local Board, Tipton, Staffordshire. |
| JERRAM, G. B., Assoc. M. Inst. C.E. | Surveyor to the Local Board, Walthamstow, Essex. |
| JONES, C., Assoc. Inst. C.E. (General Hon. Secretary.) | Surveyor to the Local Board, Ealing, Middlesex. |
| JONES, I. MATHEWS, Assoc. M. Inst. C.E. | City Surveyor, Chester. Engineer to the Dee Bridge Commissioners. |
| KNOWLES, E. | Borough Surveyor, Accrington, Lancashire. |
| LATHAM, E. D., Assoc. M. Inst. C.E. | Borough Surveyor, Middlesbrough, Yorkshire. |
| LEA, J. T. | Surveyor to the Local Board, Wallasey, Cheshire. |
| LEE, AMOS | Borough Surveyor, Stalybridge, Lancashire. |
| LEETE, WM. H. | 29, Stuart Street, Luton, Bedfordshire. |
| LEMON, J., M. Inst. C.E. (Past President.) | Consulting Engineer, Southampton. |
| LITTLE, J. | Late Surveyor to the Local Board, Torquay, Devonshire, Claremont, Torquay. |
| LIVESAY, J. G., Assoc. Inst. C.E. | Consulting Engineer to the Local Board, Ventnor |
| LOBLEY, J., Assoc. M. Inst. C.E. (Member of Council.) | Borough Surveyor, Hanley, Staffordshire. |
| LOCKWOOD, P. C., M. Inst. C.E. | Borough Surveyor, Brighton, Sussex. |
| LOFTHOUSE, J. P. | Town Surveyor, Stroud, Gloucestershire. |
| LONGDIN, T. | Borough Surveyor, Warrington. |
| LOVEJOY, C. C. | Local Board, Watford, Herts. |
| LYNDE, J. G., M. Inst. C.E. (Past President.) | The Orchard, Greenheys, Manchester. |
| LYON, E. | Surveyor to the Local Board, Barnet. |
| MCBEATH, A. G. | Surveyor to the Local Board, Sale, Cheshire. |
| MCKIE, H. U., Assoc. M. Inst. C.E. | City Engineer, Carlisle. |
| MARKS, T. T., Assoc. Inst. C.E. | Town Surveyor, Llandudno, Carnarvonshire. |
| MAUGHAN, J. | Borough Surveyor, Great Grimsby, Lincolnshire. |
| MIDDLEMISS, T. W. | Surveyor to the Local Board, Morpeth. |
| MITCHELL, J. | Borough Surveyor, Hyde, Manchester. |
| MORGAN, W. B. | Borough Surveyor, Weymouth and Melcombe Regis, Dorsetshire. |
| NEWBY, W. | Surveyor to the Local Board, Harborne, Staffordshire. |
| NEWMAN, F. | Borough Engineer, Ryde, Isle of Wight. |
| NEWTON, J., M. Inst. C.E. .. | Carlton Buildings, Manchester. Engineer to the Local Board, Bowden, Cheshire. |
| NOOT, W. | Surveyor to the Local Board, Tonbridge, Kent. |

| | |
|---|--|
| PAGAN, J. | Late Borough Surveyor, Wakefield, Yorkshire ; Surveyor-General, West Coast of Africa. |
| PARKER, J. | Borough Surveyor, Bridgwater, Somerset. |
| PARRY, A. W., Assoc. M. Inst. C.E. (<i>Member of Council.</i>) | Borough Surveyor, Reading. |
| PIDCOCK, J. H. | Borough Surveyor, Northampton. |
| PILE, PHILIP | Local Board Surveyor, Ilfracombe, Devon. |
| POLLARD, H. S. | Late Surveyor to the Local Board, Sheerness ; 2, Page Heath Villas, Bickley, Kent. |
| PORTER, R. | Borough Surveyor, Wakefield. |
| PRICE, JOHN, Assoc. M. Inst. C.E. | Surveyor to the Barton-upon-Irwell Sanitary Authority, Patricroft, near Manchester. |
| PRITCHARD, E. (<i>Past President.</i>) | 37, Waterloo Street, Birmingham, and 27, Great George Street, S.W ; <i>Hon. Secretary</i> Midland Counties District. |
| PROCTOR, J., M. Inst. C.E. .. (<i>Member of Council.</i>) | Borough Surveyor, Bolton, Lancashire. |
| PURNELL, E. J. | City Surveyor, Coventry, Warwickshire. |
| READ, RICHARD | City Surveyor, Gloucester. |
| RICHARDS, E. M., Assoc. M. Inst. C.E. | Borough Surveyor, Leamington. |
| RICHARDSON, W. A. | Surveyor to the Local Board, Tranmere, Cheshire. |
| ROBSON, O. C. | Surveyor to the Local Board, Willesden, Middlesex. |
| ROGERS, J. R. | Surveyor to the Local Board, Hornsey, London. |
| ROUNTHWAITE, R. S. | Borough Engineer, Sunderland. |
| ROWE, WM. | Tiverton, Devon. |
| ROYLE, H. | Surveyor to the Local Board, Stretford, Lancashire. |
| SADLER, G. W. | Surveyor to the Sanitary Authority, Cheltenham. |
| SALISBURY, R. | Burnham, Somerset. |
| SARGENT, B. | Borough Surveyor, Newbury, Berks. |
| SCOTT, R. S. | Surveyor to the Local Board, Ventnor, Isle of Wight. |
| SCRIVEN, W. | Borough Surveyor, Pontefract, Yorkshire. |
| SHARMAN, E. | Surveyor to the Local Board, Wellingborough, Northamptonshire. |
| SHARP, J. Fox, M. Inst. C.E. | Borough Surveyor, Hull. |
| SHUTTLEWORTH, F. H. | Surveyor to the Local Board, Littleborough, Lancashire. |
| SMETHURST, J. H. | Municipal Offices, Liverpool. |
| SMITH, E. B. | Late Surveyor to the Local Board, Sanitary Engineer, Oswald Road, Oswestry, Salop. |
| SMITH, G. F. | Surveyor to the Local Board, Milverton, War- wickshire. |
| SMITH, H. O. | Engineer to the Commissioners, Chiswick, Mid- dlesex. |
| SMITH, J. H. | Borough Surveyor, Taunton, Somersetshire. |
| SMITH, J. W. M. | Borough Surveyor, Wrexham, Denbighshire. |
| SPENCER, J. P., Assoc. M. Inst. C.E. | Late Borough Surveyor, Tynemouth, Northumber- land, 9 Dean Street, Newcastle-on-Tyne |
| SPRINGALL, W. E. | Late Town Surveyor, Folkestone, Kent. |
| STAINTHORPE, T. W. | Surveyor to the Urban Sanitary Authority, Town Hall, Loftus, Saltburn-by-the-Sea. |
| STUBBS, WM. | Borough Surveyor, Over Darwen. |
| SUNDERLAND, T., Assoc. M. I. C. E. | Borough Surveyor, Blackpool. |
| SWARBICK, JOSEPH | Surveyor to the Local Board, Withington, near Manchester. |
| TAYLOR, H. | Surveyor to the Local Board, Clevedon, Somerset. |
| TAYLOR, J. H., Assoc. M. Inst. C.E. | Borough Surveyor, Barnsley. |

MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS. xi

| | |
|--|--|
| THOMAS, W., Assoc. M. Inst. C.E. | Borough Surveyor, Dorchester. |
| THOMPSON, G. | All Saints Chambers, Derby. |
| THOMPSON, R. | Surveyor to the Local Board, Waterloo, near Liverpool. |
| THOMS, G. E., Assoc. M. Inst. C.E. | Borough Engineer, Wolverhampton. |
| THOMSON, P. W. (<i>Member of Council.</i>) | Surveyor to the Local Board, Willington Quay, Northumberland; <i>Hon. Secretary</i> Northern District. |
| THORBURN, T. C. (<i>Member of Council.</i>) | Town Surveyor, Birkenhead. |
| THORBOLD, S. E. | Surveyor to the Local Board, South Stockton. |
| TILL, W. S., M. Inst. C.E. .. (<i>President.</i>) | Borough Surveyor, Birmingham. |
| TOMES, C. | Surveyor to the Local Board, Eastbourne. |
| TRAPP, S. C. | 88, Mosley Street, Manchester. |
| TUDOR, E. C. B. | Surveyor to the Local Board, Goole, Yorkshire. |
| | |
| VAWSE, R., M. Inst. C.E. .. (<i>Vice-President.</i>) | 17, Cooper Street, Manchester; <i>Hon. Secretary</i> Lancashire and Cheshire District. |
| VEEVERS, H. Assoc. M.I.C.E. | Surveyor to the Local Board, Dukinfield. |
| | |
| WALKER, T., Assoc. M. Inst. C.E. | Surveyor to the Local Board, Croydon, Surrey. |
| WARE, C. E., M. Inst. C.E. .. | Gandy Street Chambers, Exeter. |
| WHEELER, W. H., M. Inst. C.E. | Borough Surveyor, Boston, Lincolnshire. |
| WHITE, W. H., M. Inst. C.E. (<i>Member of Council.</i>) | City Surveyor, Oxford. |
| WHITLOW, HENRY | Borough Engineer, Clitheroe. |
| WILSON, WILLIAM | Surveyor to the District Local Board, Dalton-in-Furness. |
| WILSON, J. P. | Surveyor to the Urban Authority of Hindley, 19, Lord Street, Hindley, near Wigan. |
| WILSON, J. | Surveyor to the Local Board, Bacup, Lancashire |
| WINSHIP, G., Assoc. M.I.C.E. | Borough Surveyor, Abingdon, Berks. |
| WOOD, A. R. | Surveyor to the Local Board, Tunstall. |
| WRIGHT, J. | Borough Surveyor, Macclesfield, Cheshire. |
| WORSWICK, R. A. | Surveyor to the Local Board, Whitley, Newcastle-on-Tyne. |

TOWNS AND DISTRICTS REPRESENTED BY MEMBERS OF THE ASSOCIATION.

| | |
|------------------------------------|-----------------|
| ABINGDON | G. Winship. |
| ACCRINGTON | E. Knowles. |
| ALDERSHOT | J. Galsworthy. |
| ASHTON-UNDER-LYNE | J. T. Earnshaw. |
| ASTON MANOR | W. Batten. |
| " | J. W. Brown. |
| AUDENSHAW | J. H. Burton. |
| | |
| BACUP | J. Wilson. |
| BARNET | E. Lyon. |
| BARNSELY | J. H. Taylor. |
| BARROW-IN-FURNESS | W. H. Fox. |
| BARTON-UPON-IRWELL | John Price. |
| BARTON, EOCLES, WINTON, AND MORTON | T. Heywood. |
| BATLEY | D. Hildred. |
| BENWELL | T. Dawson. |
| BEVERLEY | J. Beaumont. |
| BINGLEY | R. Armistead. |
| BIRKENHEAD | T. C. Thorburn. |
| BIRMINGHAM | W. S. Till. |
| " | E. Pritchard. |
| BLACKBURN | W. B. Bryan. |
| BLACKPOOL | T. Sunderland. |
| BOLTON | J. Proctor. |
| BOOTLE-CUM-LINACRE | G. Biddle. |
| BOSTON | W. H. Wheeler. |
| BOURNEMOUTH | G. R. Andrews. |
| BOWDON | J. Newton. |
| BRADFORD | J. H. Cox. |
| BRIDGWATER | J. Parker. |
| BRECKNOCK | R. Davies. |
| BRIGHTON | P. C. Lockwood. |
| BRISTOL | F. Ashmead. |
| BRITON FERRY | H. F. Clarke. |
| BROMLEY | H. S. Cregeen. |
| BURNHAM, SOMERSET | R. Salisbury. |
| BURTON-UPON-TRENT | E. Clavey. |
| BURY | J. Cartwright. |
| " | J. Farrar. |
| | |
| CANTERBURY | J. G. Hall. |
| CARLISLE | H. U. McKie. |
| CHELTENHAM | G. W. Sadler. |
| CHESTER | J. M. Jones. |
| CHESTERFIELD | W. F. Howard. |
| CHISWICK | H. O. Smith. |
| CLEVEDON, SOMERSET | H. Taylor. |
| CLITHEROE | Henry Whitlow. |
| CONGLETON | W. Blackshaw. |
| COVENTRY | E. J. Purnell. |
| CROYDON | T. Walker. |

| | |
|-------------------------------------|---------------------|
| DALTON-IN-FURNESS | William Wilson. |
| DERBY | Thos. Coulthurst. |
| " | G. Thompson. |
| DEWBURY | B. C. Cross. |
| DOCHESTER | W. Thomas. |
| DOVER | M. Curry. |
| DUKINFIELD | H. Veevers. |
| EALING | C. Jones. |
| EASTBOURNE | C. Tones. |
| EPSOM | J. R. Harding. |
| EXETER | H. P. Boulnois. |
| FELLING | G. Bell. |
| FOLKESTONE | W. E. Springall. |
| GATESHEAD-ON-TYNE | J. Bower. |
| GLOUCESTER | R. Read. |
| GOOLE, YORKSHIRE | E. C. B. Tudor. |
| GRANTHAM, LINCOLNSHIRE | S. G. Gamble. |
| GREAT GRIMSBY | J. Maughan. |
| HALIFAX | E. R. S. Escott. |
| HANLEY | J. Lobley. |
| HARBORNE | W. Newey. |
| HARROGATE, W. R. YORKSHIRE | E. W. Harry. |
| HARROW | F. N. Cowell. |
| HARWICH | H. Ditcham. |
| HASLINGDEN | T. Bretherton. |
| HECKMONDWICK | T. Gledhill. |
| HEREFORD | G. Cole. |
| HINDLEY | J. P. Wilson. |
| HORNSEY | J. R. Rogers. |
| HOUNSLOW | C. M. H. Crawshaw. |
| HOVE | E. B. Ellice-Clark. |
| HULL | J. Fox Sharp. |
| HURST BROOK | J. Heys. |
| HYDE | J. Mitchell. |
| ILFRACOMBE | Philip Pile. |
| IPSWICH | E. Buckham. |
| KIDDERMINSTER | A. Comber. |
| KIRKLEATHAM | J. Howcroft. |
| LANCASTER | A. Creer. |
| LEAMINGTON | E. M. Richards. |
| LEEK | T. Frost. |
| LEICESTER | J. Gordon. |
| LEIGH, LANCASHIRE | G. Dickenson. |
| LITTLEBOROUGH | F. H. Shuttleworth. |
| LIVERPOOL | C. Dunscombe. |
| " | G. F. Deacon. |
| " | J. H. Smethurst. |
| LLANDUDNO | T. T. Marks. |
| LOFTUS, SALTBURN-BY-THE-SEA | T. W. Stainthorpe. |
| LONGTON | A. Hardwicke. |
| LOWESTOFT | R. H. Inch. |
| LUTON, BEDFORDSHIRE | W. H. Leste. |

| | |
|-------------------------------------|-------------------------|
| MACCLESFIELD | J. Wright. |
| " | H. S. Aspinwall. |
| MAIDSTONE | J. S. Anscomb. |
| MANCHESTER | J. Allison. |
| " | J. G. Lynde. |
| " | B. Vawser. |
| MERTHYE TYDFIL | S. Harpur. |
| MIDDLESBROUGH | E. D. Latham. |
| MILVERTON | G. F. Smith. |
| MORPETH | T. W. Middlemiss. |
| NELSON | W. Dent. |
| NEWBURY | B. Sargent. |
| NEWCASTLE-UPON-TYNE | A. M. Fowler. |
| NEWTON-IN-MAKERFIELD | R. Brierley. |
| NORDEN | W. E. Heap. |
| NORTHAMPTON | J. H. Pidcock. |
| NORTH BIERLEY | J. Cook. |
| OLDBURY | J. Davis. |
| OLDHAM | A. Foote. |
| OSWESTRY | E. B. Smith. |
| OVER DARWEN | W. Stubbs. |
| OXFORD | W. H. White. |
| PLYMOUTH | H. Alty. |
| " | R. Hodge. |
| PONTEFRAC T | W. Scriven. |
| PRES COT | W. Goldsworth. |
| PRESTWICH | S. C. Trapp. |
| READING | A. W. Parry. |
| REDDITCH | T. W. Baylis. |
| REIGATE | J. H. C. B. Hornibrook. |
| RHYL | Robt. Hughes. |
| ROCHDALE | T. Hewson. |
| ROCHESTER | W. Banks. |
| ROTHERHAM | G. Jennings. |
| RYDE | F. Newman. |
| SALE | A. G. McBeath. |
| SELBY, YORKSHIRE | J. Holmes. |
| SHEFFIELD | R. Davidson. |
| SHEWSBURY | J. G. Butler. |
| SKELTON | John Downie. |
| SOLIHULL, WARWICKSHIRE | A. T. Davis. |
| SOUTHAMPTON | J. Lemon. |
| SOUTHPORT | W. Crabtree. |
| SOUTH SHIELDS | M. Hall. |
| SOUTH STOCKTON | S. E. Thorrold. |
| STALYBRIDGE | Amos Lee. |
| STAPLETON | J. P. Curtis. |
| STOCKTON-ON-TEES | J. Hall. |
| STRATFORD-ON-AVON | T. T. Allen. |
| STRET FORD | H. Royle. |
| STROUD | J. P. Lofthouse. |
| ST. GEORGE, GLOUCESTERSHIRE | W. Dawson. |
| ST. HELENS, LANCASHIRE | J. Hart. |

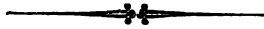
| | |
|---------------------------------|--------------------|
| ST. THOMAS, NEAR EXETER | S. Churchward. |
| SUNDERLAND | A. S. Rounthwaite. |
| SWANSEA | E. Cousins. |
| SWINDON, WILTS | T. V. H. Davison. |
| SWINTON, NEAR ROTHERHAM | J. C. Haller. |
| TAUNTON | J. H. Smith. |
| TEDDINGTON | T. Goodchild. |
| TEWKESBURY, GLOUCESTERSHIRE .. | W. H. Gray. |
| TIPTON, STAFFORDSHIRE | W. M. Jepson. |
| TIVERTON, DEVON | Wm. Rowe. |
| TONBRIDGE | W. Noot. |
| TORQUAY | J. Little. |
| TOXTETH PARK, LIVERPOOL | J. A. Hall. |
| TRANMERE | W. A. Richardson. |
| TUNSTALL | A. R. Wood. |
| TYNEMOUTH | J. P. Spencer. |
| VENTNOR | R. S. Scott. |
| „ | J. G. Livesay. |
| WAKEFIELD | J. Pagan. |
| „ | R. Porter. |
| WALLASEY | J. T. Lea. |
| WALSALL | W. J. Boys. |
| WALTHAMSTOW | G. B. Jerram. |
| WANSTEAD | J. T. Bressey. |
| WARMINSTER | T. Cruse. |
| WARRINGTON | T. Longdin. |
| WARWICK | T. Broughton. |
| WATERLOO, LIVERPOOL | R. Thompson. |
| WATFORD | C. O. Lovejoy. |
| WEDNESBURY | J. W. Fereday. |
| WELLINGBOROUGH | E. Sharman. |
| WEST BROMWICH, STAFFORDSHIRE .. | J. T. Eayrs. |
| WEST DERBY, LIVERPOOL | E. H. Allies. |
| WEST HAM, LONDON | L. Angell. |
| WEYMOUTH AND MELCOMBE REGIS .. | W. B. Morgan. |
| WHITLEY | R. A. Worswick. |
| WHITWORTH | Thos. Holt. |
| WILLENHALL | B. Baker. |
| WILLESDEN | O. C. Robson. |
| WILLINGTON QUAY, NORTHUMBRLAND | P. W. Thomson. |
| WITTINGTON | J. Swarbrick. |
| WOLVERHAMPTON | G. E. Thoma. |
| WOODFORD | J. D. Hooper. |
| WORKSOP | J. Allsopp. |
| WREXHAM | J. W. M. Smith. |

RULES OF THE ASSOCIATION.

- I.—That the Society be named the “ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.”
- II.—That the objects of the Association be—
- a. The promotion and interchange among its Members of that species of knowledge and practice which falls within the department of an Engineer or Surveyor engaged in the discharge of the duties imposed by the Public Health, Local Government, and other Sanitary Acts.
 - b. The promotion of the professional interests of the Members.
 - c. The general promotion of the objects of Sanitary Science.
- III.—That the Association consist of Civil Engineers and Surveyors holding chief permanent appointments under the various Municipal Corporations or Sanitary Authorities within the control of the Local Government Board, and such Honorary Members as shall be elected by the Council. Members who cease to hold such appointments after the Annual Meeting of the Association in 1881 are eligible for re-election by the Council, but will be disqualified from holding any office.
- IV.—That the Affairs of the Association be governed by a Council, consisting of a President, Three Vice-Presidents, Twelve Members, and an Honorary Secretary, to be elected annually. The Past Presidents and the District Secretaries for the time being shall also be Members of the Council.
- V.—That the Council shall nominate one name for President, six for Vice-Presidents, one for Hon. Secretary, and twenty-two Ordinary Members from which to elect the Council. Such Nominations shall be printed and sent to each Member of the Association not less than fourteen days previous to the Annual Meeting. Every Member shall be entitled to vote for or erase any of such Nominations, or substitute other names, subject in all cases to the limits of Rule IV., and return the same within seven days from the date of issue. Such ballot papers shall be examined in London by the President, Secretaries and two Scrutineers appointed at the previous Annual Meeting, or by any two of the aforesaid Members.

- VI.—That the Association be formed into District Committees which shall include the whole of the Members. Such Committees shall meet from time to time, in convenient centres, for the discussion of matters of local and general interest connected with the Association. Each District Committee shall appoint a Local Secretary, who will keep records of local proceedings, and communicate with the Council. No District Committee or Local Secretary shall be entitled either to represent or act on behalf of the Association.
- VII.—That a General Meeting and Conference of the Association shall be held annually in such towns, in rotation, as may afford convenient centres for assembling the Members.
- VIII.—That an entrance-fee of One Guinea, and a subscription of One Guinea per annum, from Civil Engineers and Surveyors under Rule III., shall constitute Membership of the Association.

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.



EIGHTH ANNUAL MEETING.

BIRMINGHAM, *July 7th, 8th, and 9th, 1881.*

FIRST DAY'S PROCEEDINGS.

GENERAL BUSINESS.

THE Members having assembled in the Council Chamber of the Municipal Buildings, Mr. A. W. Morant, President, took the chair, and the Minutes of the Annual Meeting held in Leeds in May 1880 were read, confirmed, and signed.

The SECRETARY then read the Annual Report for the year ending April 30th, 1881.

ANNUAL REPORT.

In presenting this report, the Council has pleasure in congratulating the Association on the maintenance of its success and continued progress during the past year.

Since the last Annual Meeting, which was held at Leeds at the end of May, five District Meetings have been held. At Darlington, on the 24th September; at Salford, on the 5th November; at Blaydon-on-Tyne, on the 25th February; at Hanley, on the 13th May; and at Barnsley, on the 28th May. These Meetings were well attended, the visits to works highly instructive, the papers in each case good, and the discussions well sustained.

The Council has to announce that twenty-five new Members have joined the Association during the financial year, whilst it regrets to have to report the death of three Members, Messrs.

E. L. Stephens, of Leicester; J. Galsworthy, of Aldershot; and J. Craggs, of Shildon. Six Members have resigned, and five Members having given up their official appointments have not sought to be enrolled. Six Members not having paid their subscriptions, the Council regrets having had to write their names off the books, and one name for other reasons has had to be expunged. The number of Members on the roll of the Association at the close of the year was 5 Honorary Members, 199 Ordinary Members, or in all 204.

The Council venture to repeat the request put forth in previous Annual Reports that the Members will make every effort to increase the roll of the Association by inducing their brother officers not yet connected with the Association to become Members of the same, and so by an addition to their numbers increase its efficiency and consequent usefulness.

In accordance with the rules of the Association, the ballot lists were issued, with the result that the following gentlemen have been elected to the Council.

President.—W. S. Till.

Vice-Presidents.—J. Allison, C. Dunscombe, and R. Vawser.

Ordinary Members of Council.—H. Alty, H. P. Boulnois, W. B. Bryan, R. Davidson, A. M. Fowler, S. Harpur, T. Hewson, J. Lobley, A. W. Parry, J. Proctor, T. C. Thorburn, and W. H. White.

General Honorary Secretary.—C. Jones.

Treasurer.—Lewis Angell.

The Council considers the accompanying balance sheet highly satisfactory, as showing that the receipts have exceeded the expenditure by 82*l.* 5*s.* 7*d.* The statement of assets and liabilities also shows that the Society continues to be in a thoroughly sound financial position.

Since the last Annual Report, our esteemed friend Mr. Graham Smith having resigned the office of Secretary, which he had so satisfactorily held, owing to its being necessary for him to be free to go abroad on professional duties, Mr. Thomas Cole, Assoc. M.I.C.E., was unanimously appointed to succeed him; and the Council believes it has secured the services of a gentleman qualified and willing in every way to promote the interests of the Association.

Mr. E. PRITCHARD moved the adoption of the Report, which was seconded by Mr. McKie, and carried.

Mr. ANGELL stated that he wished to mention to the meeting the election of Mr. Cole as Secretary, and although the meeting had confirmed it formally in adopting the Report, he wished it to be specially confirmed.

Mr. PARRY seconded Mr. Angell's motion, and Messrs. Pritchard and Jones supported it; each of the speakers paying a tribute of praise to the late Secretary, Mr. Graham Smith, for his zeal and interest in the cause of the Association, and acknowledging the same earnestness in his successor.

The PRESIDENT, in warmly endorsing what had been said, put the motion to the meeting, and it was carried unanimously.

Mr. A. W. Parry and Mr. W. H. White were unanimously appointed auditors for the ensuing year.

Mr. J. A. HALL proposed that each Member of this Association be respectfully requested to give an outline of the constitution of the City, Borough, or District for which he holds his appointment as Engineer, and submitted in writing the headings of the proposed information.

The HON. SECRETARY moved that the same be first considered by the Council. This was seconded by Mr. VAWSER, agreed to by the proposer, and carried.

Mr. ALLISON then moved the rules in the subjoined form as there amended, with the exception of the concluding words in italics in Rule III.

Rule III.—“That the Association consist of Civil Engineers and Surveyors holding chief permanent appointments under the various Municipal Corporations or Sanitary Authorities within the control of the Local Government Board, and such Honorary Members as shall be elected by the Council. Members who cease to hold such appointments after the Annual Meeting of the Association in 1880 are eligible for re-election by the Council, but will be disqualified from holding any office, *and from voting upon any matter affecting the Association.*”

Rule V.—“That the Council shall nominate one name for President, six for Vice-Presidents, one for Hon. Secretary, and twenty-two ordinary Members from which to elect the Council. Such nominations shall be printed and sent to each Member of the Association not less than fourteen days previous to the Annual Meeting. Every Member shall be entitled to vote for or erase any of such nominations, or substitute other names, subject in all cases to the limits of Rule IV., and return the same within seven days from the date of issue. Such ballot papers shall be examined in London by the President, Secretaries, and two scrutineers appointed at the previous Annual Meeting, or by any two of the aforesaid Members.”

Mr. PARRY seconded the proposition. A discussion then followed as to the year 1880 in Rule III., and finally it was suggested by Mr. Lobley that the year 1881 be inserted instead of 1880. With this alteration it was put to the meeting and carried.

Messrs. Lewis Angell and A. W. Parry were unanimously elected scrutineers for the ensuing year.

Mr. C. JONES, Hon. Sec., announced that the next Annual Meeting would be held in London.

Mr. MORANT said he had now the pleasure of introducing to the meeting his successor as President of the Association, Mr. Till, of Birmingham. Mr. Till had been a regular attendant at the various meetings of the Association, and he had no doubt felt a deep interest in its prosperity. He had great pleasure in introducing Mr. Till, and now vacated the chair in his favour.

Mr. TILL, Borough Engineer of Birmingham, having taken the Presidential chair, expressed his thanks for the kind way in which he had been introduced by Mr. Morant, and for the gratifying manner in which he had been received by the Association. He could only assure them that he would do his best satisfactorily to discharge the duties of the honourable position in which he had been placed.

A vote of thanks to the retiring President was proposed by Mr. Pritchard, seconded by Mr. Lynde, and carried unanimously.

The President then delivered his inaugural address.*

CHAS. JONES, *Hon. Sec.*

THOMAS COLE, *Secretary.*

* This Address, and the other papers read at the Meeting, will be found at the end of the volume.

Dr. STATEMENT OF RECEIPTS AND EXPENDITURE FOR YEAR ENDING APRIL 30TH, 1881. **Cr.**

| RECEIPTS. | | £ | s. | d. |
|------------------------------------|----|------|----|----|
| To Balance at Bank (May 1st, 1880) | .. | 149 | 4 | 0 |
| " Entrance Fees | .. | 26 | 5 | 0 |
| " Subscriptions | .. | 183 | 15 | 0 |
| " Arrears | .. | 25 | 12 | 4 |
| " Publisher's Sale of Proceedings | .. | 23 | 7 | 2 |
| " Private do. | .. | 1 | 0 | 0 |
| " Balance of Petty Cash—Mr. Smith | .. | 1 | 16 | 4 |
| " Do. | .. | 0 | 4 | 7 |
| <hr/> | | | | |
| | | £411 | 4 | 5 |
| <hr/> | | | | |
| Balance, May 1st, 1881 | .. | £82 | 5 | 7 |
| <hr/> | | | | |

BALANCE SHEET.

| STATEMENT OF ASSETS AND LIABILITIES, APRIL 30TH, 1881. | | £ | s. | d. |
|--|----|------|----|----|
| LIABILITIES. | | £ | s. | d. |
| To Estimated Liability on vol. vii. | .. | 80 | 0 | 0 |
| " Sundry Printing | .. | 5 | 0 | 0 |
| " Outstanding Accounts | .. | 0 | 0 | 0 |
| " Balance | .. | 93 | 11 | 1 |
| | | £128 | 11 | 1 |
| <hr/> | | | | |
| ASSETS. | | £ | s. | d. |
| By Balance at Bank | .. | 23 | 4 | 0 |
| " Subscriptions in Arrear | .. | 5 | 16 | 0 |
| " " less 25 per cent. bad | .. | 57 | 15 | 0 |
| " Proceedings in Stock | .. | 28 | 17 | 6 |
| " " less 50 per cent. | .. | £128 | 11 | 1 |
| <hr/> | | | | |
| Balance, May 1st, 1881 | .. | £93 | 11 | 1 |
| <hr/> | | | | |

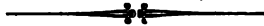
Examined and found correct, ALBERT W. PARRY, } Auditors.
WM. HY. WHITE,

CHAS. JONES, Hon. Secretary.
THOMAS COLE, Secretary.

DISTRICT MEETING AT DARLINGTON,

September 24, 1880,

*Held in the Council Chamber, Town Buildings, Darlington,
Mr. A. W. MORANT, President, in the Chair.*



THIS being the first District Meeting of the Association, held under the auspices of the recently-formed Northern Branch, the President pointed out that the first duty of the gentlemen present was to appoint a district Secretary.

Mr. J. P. SPENCER accordingly proposed that Mr. P. W. Thomson, Local Board Surveyor of Willington Quay-on-Tyne, should be elected Honorary Secretary for the Northern District. This was seconded by Mr. James Craggs. Mr. A. M. Fowler, in supporting the motion, stated that Mr. Thomson had taken a very active part in organising and bringing about a Meeting at Darlington. On the motion being put to the Meeting it was carried unanimously.

Mr. P. W. THOMSON, in signifying his acceptance of the post, thanked the Meeting for the honour it had conferred upon him, and said that he had long experienced the want of a branch of the Association in the north similar to those which already existed in different parts of the country. He was amply repaid for any trouble he had been put to in organising the Branch by having his hopes realised.

He wished that some other gentleman had been appointed to the office, but, seeing that it was the wish of the Members that he should continue to act, he should endeavour as hitherto to discharge the duties efficiently. He could not allow the opportunity to pass without acknowledging the great assistance he had received from Mr. A. M. Fowler and Mr. J. Hall. He specially thanked Mr. Hall for the assistance he had rendered in making the arrangements for the present Meeting.

Mr. A. W. MORANT congratulated the Meeting on having found a gentleman so well fitted to the duties willing to undertake the

post of Honorary Secretary of the District, and the Members present for having formed themselves into a Northern Branch Association. He said he felt sure that they would experience great benefit from the step they had taken. The calling together of the Members in various parts of the country had the effect of enabling the Members of the Association to become acquainted with one another, and provided opportunities for seeing and noting anything which might be of service to them in their professional work. The Association, he stated, had been on its trial for some years, and he believed its effects had been very good, and he hoped that year by year it would become of greater influence and importance.

The following papers were then read and discussed:

THE DISPOSAL OF THE SEWAGE AT SHILDON.

BY JAMES CRAGGS, SURVEYOR TO THE SHILDON AND EAST
THICKLY LOCAL BOARD.

IN this paper the author proposes to give a brief outline of the scheme of sewerage and sewage disposal which he designed and has nearly completed for the Shildon and East Thickly Local Government District. With a view to enable the Members of the Association to follow his description, he has arranged the subject under the following heads: Main Drain, Subsiding Tanks, Under Drainage, and Surface Preparation.

I. *Main Drain*.—The sewage of this district is conveyed by an egg-shaped brick sewer 2 feet 3 inches by 3 feet 3 inches, built of 9-inch common brickwork, the inner rim being laid in cement, and the outer in lime mortar. It has a gradient of about 1 in 400, which fall, in the author's opinion, is ample in all cases where any part of the district to be drained is considerably above the main sewer, the length of the main sewer is nearly a mile, and the contract price was somewhat below the estimated cost of 1800*l*., including the cost of constructing sixteen manholes. The population of the district is 10,000, but sufficient capacity has been provided in the outfall drain for 50,000. This will be plainly seen when it is stated that only sewage is allowed to enter these drains, provision being made for rainfall and surface water by a separate set of drains which are exclusively used for this purpose.

II. *Subsiding Tanks*.—There are two subsiding tanks, each 150 feet in length, 9 feet wide, and 6 feet deep, built of 9-inch common brickwork in lime mortar, the sides having 3-inch batter upon them. The tanks are 12 feet apart, with a paved cartway between them, the bottom of each tank is paved with bricks flat, and through each a drain is built, 1 foot 6 inches square, inside of 4½-inch brickwork, with every third half brick left out. The top of the drain is covered with 2-inch flags, dry and rough jointed, these drains are upon the same level as the upper carrier, for the purpose

of securing an even flow of the sewage. Across each tank is built a 9-inch brick wall, several bricks being left out to allow the sewage to pass through. The wall has also to some extent a tendency to prevent the sewage flowing too quickly, a result which, in the author's opinion, is very necessary, because the stiffer the sewage is kept the greater the amount of sludge retained.

The tanks are filled in in the following manner: 1st. 1 foot 2 inches of boulder stones, not larger than 10-inch cube, and diminishing to the size of fine gravel free from sand, over this is placed a covering of 4 inches of fine coke ballast. This upper layer will be required to be removed twice a year, and will form manure of a good quality, which should realise a good price per load.

III. *Under Drainage.*—The under drains are principally laid with 4-inch common tiles, and when the levelling, &c., is completed, they will be, on an average, about 6 feet deep. Two 6-inch, one 9-inch, and one 12-inch mains are laid with a final outlet main, laid with 15-inch pipes. The pipe joints are covered with a flat shaving, properly packed at each side with clay. After the joints have been made in the manner described, a slight covering of soil is then put on, after which a covering of small stones is laid 6 inches deep, and upon these is placed a covering of puddled clay 6 inches deep, properly beaten down, for the purpose of preventing the sewage from entering direct into the drains before being purified.

IV. *Surface Preparation.*—The twenty acres of land used for sewage disposal are divided into four parts, arranged upon three different levels, each plot having a gradient of 1 in 400. A properly puddled embankment is made round the whole of the land 1 foot 3 inches above the surface, to prevent the sewage saturating the adjoining fields. The four plots contain about five acres each, less embankments and roads. The sewage is conveyed from the tanks on to the high plots in a 12-inch carrier, from which it is let out on to the land by Craggs' junction blocks built into small cesspools, and thereby dispersed over the whole or any portion of the five acres by a trench ploughed parallel to the carriers. In the case of the low carrier, the sewage is conveyed by a 12-inch drain from the tanks to a manhole, constructed to resist the pressure of the sewage, where it finds its own level, and falls into a cesspool upon the same level as the carrier. In this cesspool the sewage subsides, and flows steadily and evenly into the carrier.

A cart road, 15 feet wide, will be made from east to west through the fields, with proper approaches from each plot, in order to facilitate the removal of the produce.

In conclusion, the author will only add that he trusts the Members will freely discuss and criticise the general arrangement of the scheme and the details of the work as executed.

DISCUSSION.

Mr. A. W. MORANT (President): Mr. Craggs, what do you mean when you say the pipe joints are covered with "shaving"?

Mr. J. CRAGGS: The shaving is of wood, and it having been wrapped over the joint, pieces of clay are placed in between the pipe and the earth.

Mr. MORANT: Can you tell us the cost of laying out the land per acre?

Mr. CRAGGS: The works are not completed yet, but it is something like 190 $\frac{1}{2}$., including the main drain. I hope to be able at some future time to give a more detailed account than I am in a position to do at present.

Mr. A. M. FOWLER: How many acres were purchased to provide for 10,000 inhabitants? Again, I should like to know in a scheme of this character if it is not desirable to consider the density of the sewage, to consider whether it is from a water-closet district or simply from a midden district? If it is from a water-closet district, these filter-beds will be liable to be choked up, and instead of being cleaned out once every six months, would required to be cleaned out every month. In an ordinary ashpit-district, the sewage and drainage is pretty well cleared of the thick matter before it comes into these tanks. I find that at Rugby, Leamington, and other places, they have done away with the wide roads for carrying away crops. It is found that they do not require the roads, which in some cases have been taken up; at all events, they do not use them to the extent they did. By that means they utilise the whole of their space, which in the case of roads 15 feet wide, amounts to a considerable area. Besides, there is the expense of making such roads. The depth of the drains he did not hear mentioned in the paper (Mr. Craggs: the average is 6 ft.). That is about the depth at Merthyr Tydvil.

Mr. J. HALL: Will Mr. Craggs tell us whether he has passed any sewage through these tanks, and, if so, will he give us informa-

tion as to the sewage after it has passed through the various strata he has mentioned? In Stockton, we are about to construct some sewage works, with five tanks; but I have not considered it necessary to have boulder-stones at the bottom.

Mr. T. GLEDHILL: Will Mr. Craggs inform us what quantity of sewage he has per day, and what proportion is domestic, and what proportion is manufacturing sewage?

Mr. T. W. STAINTHORPE: Will the author inform us why so large a tract of land has been taken for a population of only 10,000? It seems a large area unless an increase in population is contemplated.

Mr. R. VAWSER: I shall be glad if the author of the paper will inform us as to his method of disposing of the sludge. As I understand it, the whole of the sewage is passed direct from the main drain into the tanks, and the clarified liquid finds its way into the drain beneath the tanks and thence on to the land, the sediment the sewage being retained by the boulders of gravel and ballast in the tanks; and these tanks, the author tells us, will require to be cleansed twice a year. I don't observe that any arrangement is made for removing the sludge to prevent it accumulating on the ballast, and I presume it is intended simply to dig it out twice a year. The author does not tell us whether his plan has been in work, nor how it answers in practice. I shall be glad likewise to hear something as to the distance between the drains; the author tells us the average depth of the drains, but he does not tell us their distance apart, nor the nature of the soil in which they are placed. The question has been asked, whether the quantity of land is not more than is needed. If the soil is stiff, probably a much larger quantity will be needed. If Mr. Craggs will tell us the cost of the work, it will be useful.

Mr. CRAGGS: The number of acres of land that we are laying out for the purification of our sewage is twenty. We have a road right through from beginning to end, and a percentage must be taken off in respect thereto. The district is not a water-closet district; at least, there are not more than half-a-dozen water-closets in the district. They are all middens, such as you find in a rural district. The depth of the drains is on the average something like 6 feet; some are 8 feet, but their depth is regulated by the lay of the ground and other circumstances. Roads have been constructed. I don't think we need them; but it was the wish of my Board, and I was obliged to have them made. So far as the

quantity of sewage is concerned, I think it will run from 100,000 to 120,000 gallons per day. I believe our water supply is 10,000 gallons per day, which is rather a small supply. But the large area of land drained into our district goes into a separate set of drains, and we have nothing coming into our drains except the surface water from the yards and sewage. I should consider from 100,000 to 120,000 gallons of sewage will be about all we have. Having tested it, I find that this is near hand the mark. The land is somewhat of a clayey nature. I think it has gravel in it, but nevertheless it is rather clayey. I could not see my way clear to recommend anything less than 20 acres under the circumstances. Besides, it is a mining district, and the probabilities are that in twenty or thirty years the population may be two, three, or even four times its present number.

Mr. MORANT: Will you tell us what you paid for the land?

Mr. CRAGGS: We did not buy the land. We have a lease of it for forty years, at 7l. 10s. per acre, which is rather a high rent.

Mr. MORANT: What distance are the drains apart?

Mr. CRAGGS: 15 feet to 18 feet.

Mr. VAWSER: Will you tell us the cost of laying it out per acre?

Mr. CRAGGS: The total cost, according to the contract, is 3800l. for the 20 acres, and this also includes the cost of the main drain.

Mr. VAWSER: Can you tell us the cost of the purification works alone, apart from the cost of the main sewer?

Mr. CRAGGS: The main drain, which is 1550 yards in length, will cost something like 1800l., within that sum, if anything.

Mr. VAWSER: Therefore the laying out of the land and the erection of the two tanks would cost at the rate of 100l. per acre?

Mr. CRAGGS: Yes, about that sum. With reference to the removal of the sludge from the top tanks, the paper only applies to the coke ballast. I do not apprehend that it will be necessary to remove the boulder-stones. These may last for years; in fact, I know a case in point, where they lasted from eight to nine years. I have worked a model of these tanks for nearly seven months with nothing in it but coke ballast, and I am quite satisfied that the coke ballast will not require to be taken away more than twice a year. With regard to the sludge, we have three farmers—two of whom are having gates constructed to connect their land with the sewage farm—who are very desirous that we should let them

have the refuse from the tanks whenever they may be cleaned out.

Mr. HALL: I asked a question with reference to the effluent water. What condition was the sewage in after passing through the tank?

Mr. CRAGGS: I have not analysed it, but expect to do so in a short time.

Mr. HALL: You might give us the appearance, then.

Mr. CRAGGS: It is quite as clear as the water you find in a brook at ordinary times.

Mr. VAWSER: Are these works in operation at present?

Mr. CRAGGS: No, they are simply in progress.

The CHAIRMAN: You will, I am sure, thank Mr. Craggs for the trouble he has taken in preparing the paper, which has proved very interesting. Of course, the work not being finished, we cannot give any opinion upon the success of the scheme.

SANITARY APPLIANCES.

By GEORGE BELL, SURVEYOR TO THE FELLING LOCAL BOARD.

THE author of this paper has for some time past had under his consideration the serious and long-vexed question of how best to deal with the refuse in his district of Felling—however, having introduced a new system of dealing with the ashes and privy refuse, whereby the whole is economically and cleanly disposed of, he feels pleasure in stating that his Local Board is relieved from all anxiety for the future, and the object of this paper is to give the Members of the Association the benefit of the author's experience.

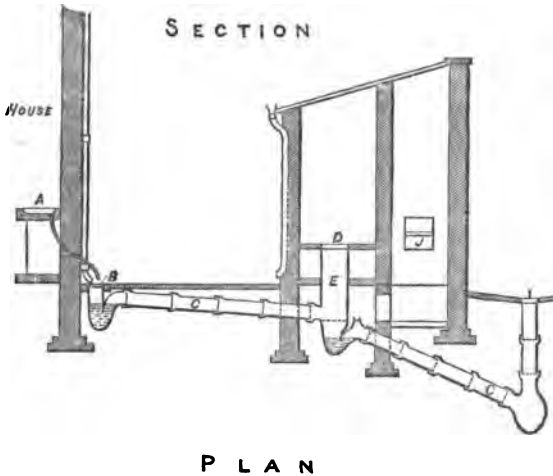
The system he has adopted will eventually be a boon to the public at large, more especially to the working classes, it being a simple and efficient arrangement. It comprises a self-acting water-closet and dry ashpit combined, designed and patented by Mr. Alfred M. Fowler, M. Inst. C.E., Borough Engineer, Newcastle-upon-Tyne.

The closet is formed by fixing a syphon pan under the seat of the closet, at such a level that the slop and waste water from the sink and the slops from the rooms of the house (discharged on to the grate in the yard), and the rain water from the roofs, is directed by a covered drain into the syphon pan, which is lengthened from the underside at the seat, to suit the level of the drain from the trapped grate in the yard. The general arrangement is clearly shown by the accompanying section and plan.

The author has used several in his district during the last twelve months, with the most satisfactory results. He can thoroughly recommend them, as the system has all the advantages of the ordinary w.c. for outside closets without the intricate mechanical arrangements.

There is no machinery, consequently it is most suitable for tenement and working-class property. Being simple in construction, it is quite impossible for the system to get out of order. There is no expense in obtaining town's water, as all the slops and refuse water from the house and yard pass through the closet,

maintaining almost a constant flow of water, thereby preventing any lodgment of excreta in the pan of the closet. There is not the slightest smell or nuisance where the closets are adopted.



A Sink in scullery. *B* Gully grate to receive slops from sink, bedrooms, all refuse water from the premises, and rain-water from roof. *C* Drain to convey all refuse, and waste water. *D* Seat of privy. *E* Sanitary tube to form lengthened pan. *G* Drain conveying sewage to main in passage or back street. *H* Main sewer. *I* Gully grate for surface water in passage. *J* Opening for ashes, can be fixed at any height above the yard with cinder-sifter if required. *L* Garbage tub, may be placed in position shown or otherwise.

Drought or frost cannot affect or injure the working of this system of w.c., as all the refuse water from the house and premises is greatly in excess of what passes through any ordinary w.c. The author has found in his own experience, more especially during the past two-and-half years of his office as Surveyor to the Felling Local Board, that the greatest sanitary evil to contend with is the privy system. In many places the privies and ashpits are only two or three yards from the dwelling house, having four or more families using one common privy. The stench from these middens is very bad, and the emanations from them, without doubt, have often been the cause of typhoid and other malignant fevers. The author is convinced that if the system which he has adopted becomes thoroughly known, having cheapness, cleanliness, and simplicity to recommend it, the privy system, with all its filth, will be gradually swept away. It is not necessary for the author to point out to you the expense and disgusting manual labour in connection with the privy or the tub system, as it is well known to every sanitary engineer, and now when the scarcity of water supply for our towns and villages is engrossing so much attention, it behoves sanitary engineers to consider how they can economise this article without interfering with comfort or cleanliness.

The system adopted at Felling meets the case most effectually. It is, indeed, the right thing in the right place. The ashes collected are free from any excrement, and instead of being a nuisance, can be used for street foundations, filling up excavations, or other work. The w.c. has also been used outside his own district, and in every case it has given the greatest satisfaction.

DISCUSSION.

Mr. A. W. MORANT (President): Can any gentleman who may have used these closets corroborate Mr. Bell's statement?

Mr. M. HALL: In the borough I represent, we are commencing to introduce these water-closets. Those already put in seem to answer admirably, more especially for tenemented property.

Mr. R. VAWSER: There is evidently a great deal yet to be learnt in Mr. Bell's district. I should think four houses to one closet, whether Mr. Fowler's or anyone else's, will be a great nuisance. I hope they don't continue to build four houses to one closet, in these days of sanitary improvements. I had, some time ago, the opportunity of seeing Mr. Fowler's closet in operation. As an

occasional observer of it I was highly pleased with its efficiency. I don't pretend to give a positive opinion as to its efficiency, as I have not watched it continuously for a sufficient length of time; but I think there is a great deal of merit in the system; and in those places where changes are to be made, I would strongly recommend the Surveyor of the district to make himself acquainted with the system, as well as with others. I have had some experience of the tub system to which Mr. Bell has referred, and although I am not disposed to call it hard names, I must say that in my opinion it does not meet the difficulties of the situation, and cannot be looked upon as a permanent cure for the wretched state of things which prevailed in Lancashire and Yorkshire a few years ago. We know that ordinary water-closets with complicated machinery, or even water-closets with the simplest machinery that can be devised, are unfitted for cottage use, but they are still more unfitted when more than one house uses the same closet. For this reason, I think that Mr. Fowler's closet deserves very careful consideration—not his system as patented particularly, but any system of closet which utilises the waste water, removes the soil into the sewer, and gets rid of it without the tub system.

MR. T. GLEDHILL: This is such a vexed question, and so much depends upon its proper settlement, that any time given to it will prove of great service to the community. I should like to ask Mr. Fowler how he manages to get the pan of the closet clean?

MR. GEORGE BELL: From the sink in the yard.

MR. GLEDHILL: How about the disposal of the ashes? Mr. Bell says they will be fit for filling up excavations.

MR. BELL: Yes.

MR. GLEDHILL: Do you consider it safe thus to use ashes, dry dust, and all kinds of refuse?

MR. BELL: We separate the garbage.

MR. GLEDHILL: You have to prevail upon the people to make use of the separate tubs.

MR. BELL: It is only a question of the Sanitary Inspector looking after them.

MR. J. P. SPENCER: Without entering into the merits of this particular water-closet, without having had an opportunity of testing it, it seems to me to contain several very good properties. At the same time, I must take a little exception to the author of the paper's wholesale condemnation of the tub system. Of course, as you are aware, there are more systems than one of that kind,

and what Mr. Bell's experience of the tub system may have been, what particular system he alludes to, I don't know. But I think to condemn the tub system without consideration is scarcely up to the mark at the present time. For tenemented property, especially in such cases where there are four or six houses to one closet, I don't know any water-closet that has yet stood the trial successfully; and I question very much whether the one before us will stand it. They may be an improvement upon the complicated systems hitherto tried. But, in my opinion, the tub system would meet the case quite as well, where ashes, excreta, and everything would go into the same tub and be removed daily. As to the filling up of excavations, as mentioned by Mr. Bell, his observations on this head are scarcely in accordance with the feeling in these modern times, when weekly we meet with condemnations of the abominable system of filling up excavations with ashes, or indeed with anything, except what is known as builders' hard rubbish.

Mr. J. CRAGGS: How are the closets affected by frost in winter? and are the water-closets affected in the same way?

Mr. A. W. MORANT: Are the closets being used in single cottages, or are they being used in common amongst a number of cottages? Suppose back-to-back houses, and you require one for four families?

Mr. BELL, in reply, said: As to the efficiency of the trap system, I have found it quite sufficient, and the closet is sweeter than any other closet I have tried. As to the ashes, there is a screen affixed to the machine where you take all the round ashes, and just the dust goes in, which is a saving in fuel and in other ways. I think the ashes taken out can be used for foundations for street paving. All last winter, the severe frosts did not affect the closet in the least. As to houses where there are a number of families, we have not put them in yet. All that we have done yet is to put them into separate houses. There is one in our own office, which works well. These ashpits must be covered in. If the screens are properly made, the ashes cannot get into the lower midden.

Mr. GLEDHILL: Suppose you have a tenant who neglects to use the garbage tub?

Mr. BELL: The Inspector of Nuisances would deal with him.

Mr. GLEDHILL: For what offence would you summon him?

Mr. BELL: Under the clause in the Act for creating a nuisance.

Mr. J. HALL: I think it would be hard if the tenants had to suffer for the absence of receptacles which the owners ought to provide.

Mr. BELL: There is the garbage tub for them.

Mr. HALL: The garbage tub may be required to be cleaned out several times a week.

Mr. VAWSER: As I understand Mr. Bell, the ashes are sifted on a screen or screens, the small ashes falling into a receptacle, and the larger ones being used again for house purposes, and that, in addition, a garbage tub was required. I must entirely dissent from Mr. Bell's conclusion if it be a point of his system to have three receptacles. I can quite understand the desirability of disposing of the garbage, but I consider it a very complicated system which introduces three separate functions into the yard of any house; for the tenants will not go to the trouble of dividing their refuse. If you can secure any system which will render the whole of the refuse innocuous, it is the best way. I don't recommend any particular system, but I may mention Fryer's as being most in accordance with my own view as to what ought to be carried out in respect to the disposal of refuse in towns. If you require three compartments in which to put your solid refuse, you do away with a great deal of the advantage which might otherwise attach to the system.

Mr. FOWLER: I have refrained hitherto from taking part in this discussion, as the remarks made did not affect my system in any way, but after the observations of Mr. Vawser, I may perhaps be allowed to say a word or two, particularly with respect to the disposal of the ashes and solid refuse, which has been the difficulty in all systems. In the Manchester and Salford district, where, as the *Builder* declared, a slaughter of the innocents was going on, there were seven different systems in operation. About four years ago, when I was engineer of Salford, the authorities felt themselves bound to do something to effect a reform, and I was called upon to devise a plan which would get rid of the stench. I put in these closets into a block near the Town Hall, and they entirely remedied the whole thing. Though, since the closets were put in, we have experienced severe winters and drougthy summers, not one of the closets has been frozen up or affected in its working capacity. As to the disposal of the garbage and the ashes, the system is very simple. There is a garbage tub in the yard into which the garbage is dropped; and the ashes which do not go

through the screen are taken back to the cottage for use. A separation of the materials is bound to take place, and if a separation takes place, one of the best deodorisers you can have is dry ashes. My system gets rid of those dépôts which you see in most of the large towns of Lancashire.

Mr. A. W. MORANT: I think it is a very good thing for cottages, and I have no objection to it. I think, however, with Mr. Vawser, that it gives trouble, and that it is better to avoid all trouble in these matters. The trough closet, I believe, has however been found to answer very well.

The Members afterwards visited the Darlington Corporation Sewage Farm, the Darlington Iron Company's Works, and the Stockton and Middlesbrough Water Company's Works.

DISTRICT MEETING AT SALFORD,

November 5, 1880,

Held at Mode Wheel, Salford,

MR. A. W. MORANT, *President, in the Chair.*

THE Members having assembled, Mr. R. Vawser was unanimously re-elected Honorary Secretary for the Lancashire and Cheshire District. The Members, under the guidance of Mr. Arthur Jacob, M.I.C.E., Borough Engineer of Salford, then proceeded to the Salford Sewage Works; the Health Committee's Dépôt at Holt Town, Manchester, where the night-soil of the town is converted into a native guano, was likewise visited.

SALFORD SEWAGE WORKS.

The Members were first shown the concrete sewage tanks now in course of formation, and Mr. Jacob explained the development of the drainage system of Salford, and described the construction of the intercepting sewer from Broughton to Mode Wheel, and the nature of the works at the latter place. Under the new system, the sewage of the borough will be delivered at the engine-house, which will be situated on the intercepting sewer. It will be then raised by a pair of powerful pumping engines and delivered into the mixing house. Here, after being mixed with lime or other chemical ingredients, it will be delivered by two cast-iron mains to the farther end of the tanks. It will next pass through the tanks towards the mixing house, where the clarified effluent water will drive a pair of vortex wheels, which will actuate the machinery of the mixing house. The effluent water will then pass into the Irwell. The works were commenced two years ago, and it is expected that another year will suffice to see them in full operation. Considerable delay was occasioned by the discovery that below the surface of the ground at certain points peat moss existed. This caused extra work, and likewise augmented the

cost of the undertaking, the original estimate for which was 25,000*l*. The tanks are 113 feet long, and have an average width of 78 feet. The total area is 108,857 square feet, and their contents when full will amount to 720,000 cubic feet.

The mud from the first two tanks will be raised by mechanical means, and will probably be sent down the river in boats to be disposed of on land belonging to the Corporation, and the sediment from the rest of the tanks, being comparatively trifling in quantity, will be flushed out into mud pits, when it will be dried by evaporation and by soakage into the subsoil.

The works are said to be nearly as large as those at Birmingham, and when finished will be the most complete and extensive in the United Kingdom.

Designs for the work were in the first instance prepared by Mr. Alfred Fowler, late Borough Engineer, but these have since undergone considerable modification at the hands of the present engineer, Mr. Jacob, under whose supervision the works are now being constructed.

THE HEALTH COMMITTEE'S DEPÔT AT HOLT TOWN, MANCHESTER.

These works are situated at Holt Town, within the city boundary. They cover an area of more than six acres, and contain the newest and best machinery, and have cost the Corporation more than 100,000*l*. They were constructed for the purpose of dealing with the refuse of one-half of the city, and the operation appears to be carried on most satisfactorily. In Manchester there are 60,000 dry-ash closets, so arranged that all the liquid and solid excrementitious matters are deposited in a pail, and automatically covered with a small quantity of fine ashes, which act as a complete deodorant. The pails, as well as the rubbish from the dust-bins, are removed in vehicles specially designed for the purpose, which contain the products of twenty-four closets. These vans, attended by two men, take out from the works twenty-four cleanly varnished pails with covers, and proceed to the several districts allotted to them. The full pails are removed from the closets, and covers placed upon them (by which they are hermetically sealed), and clean pails from the vans are substituted for them, and the rubbish from the dust boxes is placed in a separate portion of the van provided for it. Every house is thus attended to *at least* once a week, many houses twice, and some even three times weekly if found necessary. At the

works now completed, the contents of 40,000 closets, consisting of 1600 tons of refuse, are dealt with each week. The matter is collected during the day. Each van on its arrival at the works is taken charge of by a set of men, who empty the pails, wash them, and replace them. The contents of the receptacles are poured into a machine which separates the faeces from the foreign matter, the latter being used for fuel; and the former, during its progress from the top floor of the building to the bottom, is converted into a finely granulated manure, which is considered by qualified agriculturists and analytical chemists to be worth 4*l.*, and is readily sold at 3*l.* per ton. The manure is packed in bags, much resembling, and quite as inoffensive as, sacks of corn, and forms a pleasant contrast with the old system of removing the night-soil in open carts, and sending it to the farmers in all its crude offensiveness, filled with bricks, tin cans, and useless rubbish of every conceivable character. Forty tons of manure are made daily, and are sent into the agricultural districts, where it has been highly appreciated. The other rubbish, after having done its duty in creating the heat by supplying the fires of the ten 60-horse boilers in which the steam is generated for driving the machinery of this vast establishment, and being converted into clinkers in the furnaces, is ground in powerful mills with lime, and thus converted into mortar, and sold without difficulty to builders. The work has been going on in an increasing ratio during the last five years, and the arrangements connected with it appear to be perfect and complete.

The machinery employed at the works consists of about 500 horse-power, which is worked by three 60 horse-power boilers, which are fed exclusively with the refuse collected by the carts, and without any expense for fuel.

There are likewise seven similar boilers employed to evaporate the moisture from the manure, and to reduce it to a more concentrated and portable form.

Nearly 300 tons of refuse are carted daily into the works, and this is reduced as before described to about 30 tons of manure, 60 tons of fine ash, and 30 tons of clinkers; the manure is sold to farmers, the clinkers ground up for mortar, and the ashes tipped in convenient places, the whole of the ashes and clinkers being reduced to the most portable form, and rendered innoxious by fire before leaving the works.

In addition to the waste and refuse ordinarily collected, a vast quantity of foreign matter is received at the works, and ground up

and disposed of as manure; this foreign matter annually includes about 230 tons of fish, 80 tons of dogs and cats, 3000 tons of slaughter-house refuse, 3700 tons market refuse, 900 tons of pots and tins, and no less than 46 tons of glass bottles.

The whole of the work is conducted in such a manner as not to cause a nuisance in the neighbourhood, and the loss to the town is far less than by the old system of midden closets.

DISTRICT MEETING AT BLAYDON-ON-TYNE,

February 25th, 1881,

*Held at the Station Hotel, Blaydon-on-Tyne, Mr. A. M. FOWLER,
M. Inst. C.E., Borough Engineer, Newcastle-on-Tyne, in
the Chair.*

THE CHAIRMAN said that the General Secretary had written to himself and Mr. Thomson, as members of the Council, asking for an expression of opinion as to the appointment of a Secretary, owing to the resignation of Mr. Graham Smith. He thought it would be more convenient for the Members in all parts of the country, if the Secretary were located in the neighbourhood of Manchester. He therefore moved, "That this meeting is of opinion that the Secretary of this Association should reside in a central part of the country, and would suggest that some town in the West Riding of Yorkshire, or in Lancashire, should be the locality from which the selection of a Secretary should be made."

Mr. M. HALL seconded the motion, and after some discussion it was carried unanimously.

The CHAIRMAN said he had another resolution to propose; which was "That the next annual meeting of the Association for the appointment of President be held in London." Were the meeting held in a large provincial town they were bound by a sort of etiquette to elect the engineer of the place, but if they went to London, they would have the whole range of the provinces to choose a President from.

Mr. THORBOLD seconded the resolution, which was carried unanimously.

Mr. THOMSON then announced that the next meeting of the Northern District would be held in Stockton, about June or July next.

The following papers were read and discussed :

ROADWAYS.

By JAMES HALL, BOROUGH SURVEYOR, STOCKTON.

THE author will not dwell long upon the historical features of roadways, but will confine his remarks to stating that our ancestors did not profit much in the art or science of road-making from the excellent examples of highways left them by the Romans. Even towards the close of the last century, the chief means of communication between town and town was by what might be better termed a track than a road.

Mr. Arthur Young, in his 'Six Months' Tour,' published in 1770, writes of some of the roads in the North of England to Wigan turnpike:—"I know not, in the whole range of language, terms sufficiently expressive to describe this infernal road. Let me most seriously caution all travellers who may accidentally propose to travel this terrible country, to avoid it as they would the devil, for a thousand to one they break their necks or their limbs by overthrows or breakings down. They will here meet with ruts, which I actually measured, four feet deep and floating with mud, only from a wet summer. What, therefore, must it be after a winter? The only mending it receives is tumbling some loose stones, which serve no other purpose than jolting a carriage in the most intolerable manner. These are not merely opinions, but facts; for I actually passed three carts broken down in those eighteen miles, of execrable memory, to Newcastle turnpike. A more dreadful road cannot be imagined. I was obliged to hire two men at one place to support my chaise from overturning. Let me persuade all travellers to avoid this terrible country, which must either dislocate their bones with broken pavements or bury them in muddy sand."

There were at that time some decently-kept roads, but they were few and far between. When Turnpike Trusts were established, things were but little improved. The persons to whom the roads were entrusted were very often men who had no practical knowledge of road construction; or farmers,

who, having to pay their proportion of the cost of maintenance, were inclined to look very carefully before any action towards repairing the roads was commenced. This false economy was the means of wasting many thousands of pounds per annum.

An improved state of affairs arose when Telford and Macadam made road-making their study. Previous to their day, engineers had considered the question one beneath their dignity.

There are two kinds of roadways, viz. those made with broken stones, and those which are paved. The former are generally called macadamised. This, however, is not their proper name, although now generally used, as it only applies to that kind of road-making introduced by John Loudon Macadam in 1816. His practice was to lay the material upon the natural surface to a thickness of from 5 to 10 inches, and not use a formed foundation. Roads of the latter class, as their name suggests, are formed with paving materials, which consist of granite, whinstone, limestone (tough), sandstone (millstone grit formation), concrete, asphalte, wood, or scorise bricks.

The writer proposes, in the first place, to describe broken-stone roadways. These may be divided into two classes—viz. town roads and suburban. The former require stronger foundations and a much greater thickness of covering, generally termed road metal, than the latter, as the traffic is comparatively so much greater. My remarks shall apply only to roads where the traffic is at a minimum, special circumstances requiring special treatment. For town roads, the foundations are made with the material most easily obtainable, the same being hard, and as much as possible non-absorbent. In this neighbourhood (Stockton) slag is nearly always used, and makes an excellent foundation when properly laid. It is impossible to fix upon any particular material; the engineer must use the best he can get at the least cost.

The foundation of a road is its most important part, and therefore requires the greatest care in its construction. In every case the covering must be regarded only as a protection, its depth and mode of construction depending entirely upon the nature of the subsoil and the kind of traffic which the roadway is intended to accommodate.

The surface of the ground should be formed so that there is a fall to the side, and proper drains to carry off the water. Where there is a clayey formation, transverse drains should be laid obliquely from the centre to the channels, or where the drain is only at one side, from channel to channel. Those drains may be made either with ordinary field pipes, or with bricks, and filled in to the underside of foundation with loose material. In good soil, those transverse drains are not required. When the sewer or main drain is in the centre of the street, a drain should be laid at either side in the channel, a good tile in the bottom, and the trench filled in with loose materials, and connected with the sewer by proper bends and junctions. This should be done in all town streets, the side drains being laid below the footings of the walls of adjoining buildings, thus effectively draining the subsoil, and thereby removing a great cause of disease. The author has often been called upon to suggest a remedy for rendering a damp house dry, and nearly in every case he has found that, by tapping the foundations and providing proper means of subsoil drainage, a cure has been effected. Were our roadways made as suggested the foundations would drain themselves.

Three kinds of foundations are used. The first is a modification of the system used by Telford, where a penned or rough-paved foundation is constructed, and covered by a fine coating of smaller material; the second is that introduced by Macadam, in which the whole of the materials are broken into small cubes; and the third has a foundation of concrete.

The first is the penned foundation. This is made by hand-laying hard material in close contact, the largest side downwards, the interstices being filled with smaller material well wedged in. This must be formed to the camber required for the finished surface, and thoroughly rolled, or otherwise consolidated. The only difference between this and Telford's method is, that his formation was level, and he got his camber by reducing the thickness of his penning from the crown to the channel. The second, or what may be called the macadam road, is made by laying the metal on the natural surface, after it has been drained and levelled, to the depth required, the material used being broken to a small size.

The third is a kind of road formed by a concrete bottoming. The only objection to this kind of road is its first cost, which precludes its general use. In towns, however, where it is considered desirable to have a broken-stone road, a better foundation could not be obtained; one of its great advantages is that, becoming a compact mass after setting, the weight is evenly distributed over the whole surface of the roadway, thus preventing, to a very large extent, an uneven surface, which is often found in roads where the traffic is heavy. Concrete can be made both with lime, lias lime, and cement; the latter is preferable. The author intends to speak more fully of concrete in the portion of his paper which deals particularly with paved roadways. When a concrete foundation is to be used, great judgment should be exercised in the proper time the metal should be spread. Some engineers say that the concrete must be allowed to get thoroughly set, then covered with a thin coating of fine gravel (pit gravel preferred), and the required thickness of metal then spread; while others consider it better to spread the metal upon a thin coating of gravel before the concrete is set, and roll the surface until the metal has partly embedded itself in the concrete. I am strongly of opinion that the latter plan is the better. The road, however, must not be open for traffic until the concrete is quite hard, and until after the first coating of metal has been covered with a thin coat of finely-broken material.

The materials used for road-metal vary in different parts of the country. Whinstone, granite, syenite, basalt, carboniferous limestone, flints and slag; of these whinstone is the best. It makes the most durable and the cleanest roadway. In this neighbourhood we have a good supply of excellent material in our local whinstones. Granite, syenite, and basalts granulate much sooner than whin, therefore they cause a dusty road. Limestone alone is a very unsuitable material, from its great affinity for water, which causes it in dry weather to crumble to dust. When mixed with whinstone, flints, or other compact material, it is useful in causing the whole to bind quickly, and is therefore often used in roads of steep gradients, where it is difficult to get the stones bedded.

The usual sizes to which road-metal is broken are, 2 inches, 2½ inches, and 3 inches—the 2-inch for roads where the traffic

is light, such as an avenue or private road; the $2\frac{1}{2}$ -inch for ordinary roads and streets; and the 3-inch where a steam roller is used.

Road-metal is measured by a ring, through which every stone should pass in every direction. It was formerly the custom for road surveyors to carry scales to weigh the stones. Stones broken by hand make the best roadways, being broken into more regular cubes. Too much dirt or small material should not be allowed, but the author does not see the utility of screening hand-broken stones. Several stone-breaking machines are now in use, which do their work well; but it cannot be expected that they can make such regular metal as that broken by hand. Some years ago Mr. Joseph Mitchell laid down a concrete macadamised road in Edinburgh with satisfactory results. The mixture was in the following proportions:—

| | |
|---------------------------|----------------|
| Portland cement | 1 |
| Broken stones. | 4 |
| Sand | $1\frac{1}{2}$ |

The stones were well screened and watered, and the whole turned over, thoroughly mixed, and spread to a thickness of 3 to 5 inches, and allowed to harden; after which a second layer was spread, and so on until the required thickness was obtained. A road thus formed need only be about one-half or two-thirds as thick as ordinary broken-stone roads. The great objection to roads thus formed is, that when the surface becomes worn the cost for repairing them will be considerably more than that of an ordinary road.

The thickness of the foundation and metalling of broken-stone roads may be taken as follows:—

| Pinned. | Foundations. | | Broken stones. | | | Concrete. | |
|-----------------|--------------|-----------|----------------|--------|--------|-----------|------------|
| | Pinning. | Covering. | Metal. | Under. | Upper. | Concrete. | Metal, &c. |
| Country roads . | 6 in. | 3 in. | 4 in. | 9 in. | 4 in. | 4 in. | 3 in. |
| Suburban „ . | 9 „ | 3 „ | 5 „ | 9 „ | 6 „ | 6 „ | 5 „ |
| Town streets . | 9 „ | 6 „ | 5 „ | 15 „ | 6 „ | 10 „ | 5 „ |

The second part of the subject, viz. paved roadways. There are several kinds of pavements, the chief of which are chip, random, block, wood and asphalt. Chip pavement consists of irregular-shaped stones, either of granite or whinstone, evenly and neatly fitted together. Experienced workmen

make excellent work with this material. Its greatest recommendation is its cheapness in first cost, as it possesses neither the noiselessness of macadam nor the smoothness of blocks; it is used extensively for minor streets, where the traffic is merely local, in Newcastle; Gateshead, North and South Shields, and a few streets in South Stockton and Old Hartlepool. Random pavement consists of small cubes of various sizes, but all roughly squared; when sorted and laid in courses it makes a good pavement for back passages, courts and alleys.

A good foundation for chip pavement, when used in 30-foot streets, is about 9 inches of rough material hand-penned, and 4 inches of finer, broken upon the top, so that an even compact body is formed. The stones are bedded in fine gravel or hard engine ashes, and beaten down at least 2 inches with a heavy beater, and the joints filled in with lime or cement grout. At North Shields and Tynemouth, where gravel ballast is plentiful, a layer of concrete 6 inches thick is laid as a foundation and has been found to answer well.

Block or set pavement consists of properly-squared blocks of sizes suited to the nature of the traffic. For streets where the traffic is heavy, a set from 7 to 9 inches deep, and $2\frac{1}{2}$ to 3 inches wide, is found the most suitable; but for ordinary streets other than main thoroughfares a set 5 inches deep and 4 inches wide will make an excellent roadway.

Granite, syenite, and whinstone are the principal materials used. Granite, from its great hardness, lasts much longer than the others, but wears smooth; while syenite and whinstone keep rough under attrition. Thus, though safer materials, they are not so lasting. Of the latter two, the former is the most durable. As the first cost of granite and syenite is so very heavy, and whinstone so cheap in this neighbourhood, the author does not think the extra life of the former two would justify its use here, excepting under very exceptional circumstances.

The nature of the foundation required for block pavement varies with the extent and nature of the traffic, the width of the streets, and other conditions.

In Stockton, the foundation for ordinary traffic is generally specified as follows: 9 inches of rough slag, pitched by hand;

the interstices are then filled in with fine slag, and a coating of broken slag 4 inches thick on the top. The whole is then covered with ashes, raked as ruts are formed, and paved upon when thoroughly consolidated. The sets, after being rammed the first time, are grouted with lime grout, consisting of 1 of lime to 2 of sand well mixed together in a grouting tub with water. When very fine pea ballast can be obtained it is used instead of sand. The joints between the sets are $\frac{1}{2}$ inch wide.

Asphalt run into the joints is very desirable, but in ordinary streets its expense precludes its general use. The great advantage in using asphalt is in rendering impervious to water the joints of pavement, as it prevents the water from the surface damaging the foundation, which is one of the greatest causes of uneven surfaces.

When the traffic is heavy, a Portland cement concrete foundation should be used; it is everlasting, and gets better with age. One of the chief objections to its use is the difficulty and cost of obtaining access to water and gas mains and sewers. The difficulty, however, is not so great as it appears, for the concrete can be cut out in slabs and relaid when necessary, and the joints flushed up with mortar. Another objection raised, is the inconvenience involved in preparing and laying the concrete in crowded thoroughfares. There is always a certain amount of inconvenience when any works affecting the streets are being carried out. The author most certainly would advise the street to be entirely stopped; if space will not allow of the mixing of the concrete, use slow-setting cement or lias lime; mix it at some convenient place near to the works; cart it and lay it down in position. When pit gravel is used, the proportion may be from 1 to 5 to 1 to 7. When the thickness is to be 9 inches or thereabouts, large material may be thrown into the concrete.

Before leaving the subject of block paving, the author would like to say a few words about our local paving blocks, viz. the scorïæ brick. Everyone who has the welfare of the Cleveland district at heart must wish the Scorïæ Brick Company every success in their endeavour to perfect their product. There is still something wanting ere perfection can be said to have been reached. Nearly six years ago, upon the author's recommendation, the Local Board of South Stockton, the

author being their surveyor at that time, decided to give those bricks a trial, so they paved several back streets with them. The size of the brick was 10 inches by 5 inches, by $3\frac{1}{4}$ inches deep. Upon the whole they stood remarkably well, and they have been used in South Stockton ever since. In the borough of Stockton several thousands of yards have been laid, with varied success. Some were brittle, and would not stand the beater; others were hollow, and if they did stand the beater, were soon broken by the traffic. If a uniformity of material could be assured, which the author has no doubt will be the case, the bricks will stand high as a paving material. They are admirably suited for back streets, and possess great advantages on account of their smoothness. They are so much more easily cleansed, and it is a desideratum to be able to remove all trace of the visit of the scavenger.

Scoriæ bricks also have another advantage in being comparatively noiseless, compared with whinstone and granite. The size of brick used in Stockton is 9 inches long by 5 inches deep, by 4 wide. No just comparison can be made between them and the natural stones, as we have no proof how long they will last when exposed to heavy traffic or the weather. A granite block is always a piece of granite, and a whinstone block a piece of whinstone, each of which can be re-dressed or otherwise utilised, whereas a scoriæ brick is only a piece of slag. The author's remarks upon foundations for block paving will apply to scoriæ bricks. I may say that scoriæ bricks are made out of blast furnace slag, when in a certain condition and colour. It requires experienced men to know when the slag is in the proper state to make good bricks.

The slag, being tapped, runs down a trough to a revolving wheel. This wheel, which is about 30 feet in diameter, has moulds placed upon it, these moulds being of any size, according to the description of brick to be made. After the slag has filled these moulds and set, the bricks are taken off and put into a furnace, which is afterwards sealed, and the bricks go through a process termed annealing. Upon that annealing and the amount of skill exercised in getting the slag depends the quality of the brick. Upon the whole, I cannot recommend them as an economical pavement for main thoroughfares where

the traffic is heavy, but for channels and back streets I consider they are very advantageous if you can get them cheap.

Carboniferous limestone blocks are made, but cannot be recommended, as they soon grind to powder.

In some parts of this country sandstone, of the millstone grit formation, is used as a material for paving. It affords a good foothold, but is too soft for general use. In Leeds it is being taken up, and whinstone and granite substituted.

Time will not permit of the author dealing with asphalt or wood pavements. Several methods of both are now before the public, and no doubt we shall learn from Colonel Haywood, the talented engineer to the Hon. Commissioners of Sewers of the City of London, who has made many valuable reports upon the question of pavements, full particulars of their relative values.

It may be interesting to some to know the relative cost of macadamised roads and paved streets—a question which several corporations have had under their consideration for some time past.

The advantage of paved surface over macadam cannot be overestimated for cleanliness, durability, and cost of maintenance.

Some time ago the author obtained, at the request of the Chairman of the Streets and Buildings Committee of the Middlesbrough Corporation, particulars of the annual cost of maintenance of the macadamised streets in Stockton, and found it to be as follows:—

| | s. | d. | |
|---------------------------------------|-------|-----|---------------------|
| Bridge road | 1 | 6 | per yard per annum. |
| Yarm Lane | 1 | 0 | " " |
| Norton Road | 1 | 2 | " " |
| High Street (centre macadam). | 1 | 2 | " " |
| Bishopton Road | 1 | 2 | " " |
| Portrack Lane (throughout) | 1 | 0 | " " |
| Other roads | about | 0 9 | " " |

This at first glance appears to be very high; but nearly all the roads are main roads or streets. In Stockton there is very little area of what might be termed suburban roads. The author finds, from a Report of the Borough Engineer of Derby, 1876 (Mr. E. B. Ellice-Clark, Assoc. M. Inst. C.E.), the average

cost of twelve of their macadamised streets is 1s. 5·63*d.*, while those in Stockton average only 1s. 1*d.*

| | | |
|------------------------------------|-------------|---------|
| 1 ton of Whinstone costs | s. d. | |
| Spreading and leading | 8 0 | broken. |
| | 2 0 | „ |
| Total | <u>10 0</u> | |

1 cubic yard = 24 cwt., costs 12s.

| | | |
|--|------------|-----------|
| And when spread on a new road 4 inches deep. . . | 1 4 | per yard. |
| Raking in, say | 0 1 | „ |
| Total cost | <u>1 5</u> | „ |

This is allowing nothing for cleansing or rolling with steam roller.

| | | |
|---|------------|----------|
| To repair an old road, 1 cubic yard as before | s. d. | |
| | 12 0 | per ton. |
| Spread 3 inches deep | s. d. | |
| Hacking and raking in | 1 0 | |
| | 0 2 | |
| Cost | <u>1 2</u> | |

without allowing for cleansing or rolling. It must also be borne in mind that one coat of metal, 3 inches or 4 inches thick, is not sufficient for a road subjected to heavy traffic for one year. These figures will show the enormous cost of having macadamised thoroughfares in towns.

The author may here mention that a macadamised road in Bristol, 718 yards long by 13 yards wide, costs 2s. 1½*d.* per yard to maintain; and Regent Street, London, costs 3s. 7*d.* per yard per annum. In Stockton the cost of whinstone block pavement, size of stone used 5 inches deep, 4 inches wide, and random lengths, is from 5s. 6*d.* to 6s. at the present time. This is below the general average, both material and labour being at a very low rate, and abundance of material for foundations being at hand.

In a main thoroughfare with a concrete foundation, the size of blocks being 7 inches deep and 3 inches wide, run in with asphalte joints, the cost would be from 8s. to 9s. The life of

both kinds, if properly done, will be at least thirty years—say twenty-five. The cost per annum would be as follows:—

| | |
|--|--------|
| Ordinary streets, say per yard | s. d. |
| If taken up and relaid, say | 6 0 |
| | 1 6 |
| Total cost for 25 years | 7 6 |
| „ per annum | 0 3·6 |
| Value of material when taken up at end of 25 years for road-metal, per yard | 1 5 |
| Main thoroughfares say, first cost per yard | 9 0 |
| If taken up and relaid with asphalt joints. | 2 0 |
| Total cost for 25 years | 11 0 |
| „ per annum | 0 5·28 |
| Value of material, when taken up at end of 25 years, for road-metal per yard | 1 8 |

In the above statement the author has given the highest possible cost and the shortest life, so that the estimate gives the advocates of macadam every advantage.

It does not follow that when paving stones are taken up they should be broken for metal.

The author is now using old paving stones where, had he not had any, new ones would have been required, although the old ones answer the purpose equally as well.

In conclusion may be mentioned a very important consideration in judging the merits of different kinds of roadways, viz. the loss by resistance to traction, which means loss of force and loss of money.

Molesworth's formula is as follows:—

Resistance in lbs. per ton on different roads, exclusive of gravity—

| | |
|--------------------------------|------------------------|
| | lbs. per ton. |
| Stone tramways | 20 |
| Paved roads | 33 |
| Macadamised roads | 44 to 67; average 55·1 |
| Gravel | 150 |
| Soft sandy and gravelly ground | 210 |

showing that the average resistance on a macadamised road is 22 lbs. per ton more than on a paved street.

TABLE I.—GRANITE PAVEMENTS.

ABSTRACT SHOWING THE ESTIMATED COST PER ANNUM OF GRANITE PAVEMENTS
IN SOME OF THE PRINCIPAL CARRIAGEWAYS IN THE CITY OF LONDON, AS
PREPARED BY MR. HAYWOOD, CITY SURVEYOR, LONDON.

| Situation. | Description of Pavement. | Estimated Duration of Pavement. | First Cost per Square Yard. | Total Cost, including First Cost and Maintenance per Square Yard. | Average Cost per Square Yard per Annum. |
|------------------------|--------------------------|--|--------------------------------------|--|---|
| | Ins. Ins. | | s. d. | £ s. d. | s. d. |
| Cheapside | Aberdeen granite, 3 by 9 | 15 years | 16 0 | 1 4 4½ | 1 7½ |
| Poultry . | " " " | 8 " | 16 0 | 1 2 4 | 2 9½ |
| Old Broad Street .} | " " " | 20 " | 16 0 | 1 0 11½ | 1 0½ |
| Moorgate Street .} | " " " | 15 " | 16 0 | 1 0 7 | 1 4½ |
| Lombard Street .} | " " " | 20 " | 16 0 | 1 1 4½ | 1 0½ |

(No foundations are included in these estimates.)

TABLE II.

STATEMENT PREPARED BY MR. HAYWOOD UPON THE COMPARATIVE COST OF
GRANITE AND ASPHALTE PAVEMENT IN LONDON.

| Situation. | Estimated Duration of Pavement. | Total Cost per Yard per Annum. | Time to be Maintained by Con- tractors. | Total Cost per Yard per Annum. | Difference of Cost per Yard. | Remarks. |
|------------------------|--|---|--|---|------------------------------------|--|
| | | s. d. | | s. d. | s. d. | |
| Cheapside | 15 years | 1 7½ | 17 years | 2 3½ | 0 7½ | { Increased cost of as- phalte (Val de Travers). |
| Poultry . | 8 " | 2 9½ | 17 " | 2 3½ | 0 6½ | Decreased do. do. |
| Old Broad Street .} | 20 " | 1 0½ | 17 " | 1 6 | 0 5½ | Increased do. do. |
| Moorgate Street .} | 15 " | 1 4½ | 17 " | 1 6 | 0 1½ | Increased do. do. |
| | | | 18 " | 1 8½ | 0 4½ | { Increased do. (Bar- nett's). |
| | | | 17 " | 1 5½ | 0 1½ | { Increased do. (Lim- mer's). |
| Lombard Street .} | 20 " | 1 0½ | 17 " | 1 5½ | 0 4½ | Increased do. do. |

TABLE III.

TABULATED STATEMENT BY MR. HAYWOOD, SHOWING THE FIRST COST, COST OF MAINTENANCE, AND AVERAGE ANNUAL COST OF MACADAM, WOOD, ASPHALTE, AND GRANITE PAVEMENTS.

| Description of Pavement. | First Cost per Square Yard. | Cost of Maintenance per Square Yard per Annum. | Average Cost per Square Yard per Annum, spread over Sixteen Years. |
|--------------------------|-----------------------------|--|--|
| | <i>s. d.</i> | <i>s. d.</i> | <i>s. d.</i> |
| Macadam | 4 8 | 2 4 | 2 7½* |
| Wood | 18 0 | { 1 year free, 15 } years at 1s. 6d. } | 2 6 |
| Asphalte | 17 0 | { 2 years free, 15 } years at 1s. } | 2 0 |
| Granite | 16 0 | 0 9 | 1 0† |

* In most provincial towns the average would be about half this.

† The old sets are valuable at the end of 16 years for reworking or breaking up for macadam.

TABLE IV.

ROADWAYS IN THE PARISH OF ST. GILES. MR. LIVINGSTONE, SURVEYOR.

| Description. | Area in Square Yards. | First Cost per Square Yard. | Annual Outlay per Square Yard. | Total Cost for Ten Years, less Value of Material. | Average Annual Cost of Cleansing, Watering, per Square Yard, &c. | Total Cost, Ten Years, including Cleansing, Watering, per Square Yard, &c. |
|-------------------|-----------------------|-----------------------------|--------------------------------|---|--|--|
| | | <i>s. d.</i> | <i>s. d.</i> | <i>s. d.</i> | <i>s. d.</i> | <i>s. d.</i> |
| Granite | 3,520 | 6 6 | 0 2 | 5 5 | 0 4½ | 9 4½ |
| Macadam | 3,800 | 3 1½ | 5 0 | 44 0½ | 1 0½ | 54 7½ |
| Wood | 3,520 | 3 0 | 3 0 | 26 2 | 0 4½ | 30 1½ |

TABLE V.
TABLE SHOWING THE COST OF MAINTENANCE IN SEVERAL OF THE PRINCIPAL TOWNS IN ENGLAND OF GRANITE, MACADAM, AND WOOD
PAVEMENT, COMPILED BY MR. MCKIE, CITY SURVEYOR, CARLISLE.

| Name. | Total Miles of Road. | Number of Miles. | Granite Paving. Cost per Annum per Square Yard for Repairing. | Number of Miles. | Macadam. Cost per Annum per Square Yard for Repairing. | Wood. Cost per Year Square Yard for Repairing. |
|---|-------------------------|---------------------|---|---------------------|--|---|
| St. George's, Hanover Square, Piccadilly | .. | .. | 2d. | .. | 3d. to 2½d. | 1s. |
| City of London | 48 | .. | 3d. to 9½d. | .. | 1s. to 6s. | 1s. 6d. |
| Glasgow | 130 | 112 | 7d. | 18 | 8½d. | .. |
| Manchester | .. | .. | .. | .. | 1s. to 1s. 8d. | .. |
| Leeds | 185 | 95 | .. | 120 | .. .. | .. |
| Liverpool | 205 | .. | .. | 36½ | { Four times cost of pave- ment (1s. 8d.; if mixed with tar, 2s. Macadam dearest; most costly per square yard.) | .. |
| Sheffield | 190 | .. | { Last 18 to 20 years; granite cheapest to maintain . . } | .. | .. | .. |
| Bradford | 53 | 18 | .. .. | 35 | .. | .. |
| Bristol | 120 | 50 | One-fifth cost of macadam . | 70 | 1s. 8d. to 1s. 6d. | .. |

DISCUSSION.

Mr. M. HALL: I wish to call attention to that part of the paper referring to block or set pavement. The author said, "For streets where the traffic is heavy, a set from 7 to 9 inches deep, and $2\frac{1}{2}$ to 3 inches wide, is found the most suitable." I think $2\frac{1}{2}$ to 3 inches rather narrow, and perhaps 9 inches might be a little too deep. In whinstone pavement a 7-inch set would cost a good deal less, and perhaps answer the purpose better. A whinstone set $2\frac{1}{2}$ inches wide created a great many joints which would be very liable to get widened, and thereby seriously affect the lasting powers of the pavement. My idea is, that for whinstone pavement a 7-inch set will be quite as good as a 9-inch, which would perhaps make the pavement too expensive.

Mr. P. W. THOMSON: I should like to ask the author whether scoræ bricks could not, like whinstone and granite, after being used and taken up as unfit for paving, be broken up for macadamising purposes? It would make a considerable difference when the paving material could be made use of in that way. I know that it is customary to use blast furnace slag for the purpose he has mentioned; but it does not answer well, as it wears round, and refuses to bed. With reference to the laying of concrete foundations for roads, and the consequent difficulty in getting to the water- and gas-pipes and sewers, there was a project afoot at one time for placing the water-mains and sewers in a large tunnel under the streets. That idea has been abandoned, but I have never been able to ascertain the exact cause. If it could possibly be carried out, I believe that it would effect a great saving in the matter of repairs, preventing streets and roads being broken into, which, as a rule, were never so well laid, as well as a great sanitary improvement.

Mr. M. HALL: I fancy that the author of the paper has given too long a time for the life of a whinstone pavement. He said that in main thoroughfares "the life of both kinds, if properly done, will be at least thirty years—say twenty-five." After some experience of whinstone pavements, I really think it ought not to be put down at such a length of time as that. Granite pavements might be put down at twenty-five years in main

thoroughfares, but I should say for whinstone fifteen years would be more like the mark—that is, Northumberland whinstone; Fifeshire whinstone would not last anything like the time. I have a very high opinion of the Tees scoriæ bricks. About three years previously they had laid down in Shields a crossing 20 feet wide with them in their principal street. The bricks were $3\frac{1}{2}$ inches by 6 inches in size, and they were put on a concrete foundation. They seemed to be answering remarkably well. They had also used a considerable quantity for ordinary crossings, and for the channelling of macadamised roads; and from what I have seen of them I can quite bear out the remarks of Mr. Hall.

Mr. R. S. ROUNTHWAITE: I must call attention to the statement in the paper that broken whinstone is the best material for macadam. In Sunderland they rarely use anything else but Aberdeen granite from the Cove quarries, and I am inclined to think it is, if anything, better than whinstone. Then, as to the size to which the stone should be broken, I think a macadam road would be better formed if stones were broken somewhat smaller—say $1\frac{1}{2}$ inch, or even less than that, if possible. I should like to hear some opinions upon the use of steam rollers, as I have been told that, in Hull, steam rollers have done considerable damage to the gas- and water-pipes. As to the random pavement, they are using it extensively in Sunderland, and I think the maintenance of private streets generally would be reduced by its adoption. It costs them about 4s. per yard, including labour and everything. They put in a ballast foundation of 6 inches. I am inclined to agree with the author of the paper, that $2\frac{1}{2}$ inches is rather thin for set pavements, except on a very steep gradient. I should prefer 3 inches on a steep gradient, and 4 inches on a level roadway. To place the life of whinstone pavement at thirty years is rather over the mark. Some time ago I was shown, by Mr. Lamb, some streets in Newcastle laid with whinstone, which had been down fourteen years, and they were certainly not in excellent condition. It might have been due, however, to the manner in which they were laid, or to the foundation.

The CHAIRMAN: There is not a doubt of it.

Mr. ROUNTHWAITE: Mr. Hall seemed to think whinstone cheaper than granite. It cost them in Sunderland a good deal more than granite.

Mr. JAMES HALL: I may just say that you get yours as ballast. We have to get ours by rail; that makes the difference.

Mr. M. HALL: The Cove metal you get delivered into Sunderland (I have had a lot of it at Shields) at 5s. 6d. per ton. It is hard, of a red colour, and makes an excellent roadway. I believe it will just wear as long as any whinstone. I have had them side by side.

Mr. ROUNTHWAITE: Where Mr. Hall spoke of grouting the pavement, I think he was rather extravagant. I hardly see the necessity for mixing 1 of lime with 2 of sand for grouting pavement. The author advised the stopping of the thoroughfare until the repairs were done. They would all certainly do that if they dare, but from their experience they knew the complaints they produced by blocking even half a road up. I do not think Mr. Hall has made out a very good case for scorïæ bricks.

Mr. GEORGE BELL: They are going to lay our tramways with them. I know they stand very well.

Mr. ROUNTHWAITE: In Sunderland they were going to do away with the whole of their macadam roads, and pave with wood, so as to reduce the expense. They had had granite sets in their main thoroughfares for upwards of forty years, and when taking them up they had found them worn only three-eighths of an inch. They had relaid them in other streets, where probably they would last as long again.

The CHAIRMAN: Have you any returns of the traffic?

Mr. ROUNTHWAITE: I have not.

Mr. G. BELL: It all depends on the traffic.

The CHAIRMAN: In Newcastle I have introduced a new system of small set pavement as used in Manchester and Salford—4½ inches on the top by 4½ inches, and 6 inches deep. They were put into the road on the ordinary bed; there was no foundation panned, as they called it. They simply laid the sets on beds of ashes or clean gravel. The stones were well rammed, and the joints filled in with shingle, or, what was much better, with clean slag, so that the asphalte would adhere to it better, and then they ran in the asphalte boiling hot. The object of this was to make the street in a thoroughly sanitary condition. As soon as the street was made in that form, they might put a hosepipe on it and wash every particle of dirt off, thereby making a great stride towards the object they had in view—the sanitary condition of their towns. In

Manchester—in Piccadilly, for instance, where the sets were $3\frac{1}{2}$ inches on the top—some of the pavement has been down there, to my knowledge, for many years. Mr. John Frederic Bateman, late President of the Institution of Civil Engineers, said it had been down for twenty years, and it had not been disturbed except for water-pipes; and Piccadilly in Manchester was perhaps one of the busiest streets in the world. The whole of Manchester was laid with a pavement of that class. There was no foundation of penning; it was simply laid on ashes. They have done there, as I myself have done in the neighbouring borough of Salford, and in Leeds previous to that. They used to get the traffic over the new street as long as they could, to consolidate it. Then they put a layer of ashes over it, and paved on that. I assure you the streets of Manchester are the best paved in England.

In answer to questions at this point, the CHAIRMAN said in Newcastle granite was used for the sets where there was a gradient steeper than 1 in 40. Where the surface was flat they used whinstone. The cost of granite was 27s. per ton, and of whinstone 16s. 6d. per ton. They could make their own calculations as to the foundations when they reckoned that a ton of either material would pave $3\frac{1}{2}$ square yards. One of the speakers had referred to the width between sets, and to the time they had been down. One of them had been shown by Mr. Lamb, in Newcastle, a street where they were worn after being down for fourteen years. Whinstone sets ought to be down at least twenty years without any difficulty; but if they laid the sets wide apart, they worked round on the surface. The consequence was that the traffic made a great noise, and when the sets once began to disintegrate at the arrises the damage went on increasingly. Noise, too, was almost as detrimental to health as dirt itself, and if heavy carts had to pass over the round-topped stones in the streets, the noise produced opposite business premises was simply unbearable. In Salford they had laid a pavement of whinstone taken from North Wales. It was laid with these stones $4\frac{1}{2}$ by $4\frac{1}{2}$, and 6 inches deep, and was laid in asphalt. It lay in the street, which was one of the busiest in England, for fifteen years. It wore uniformly, and not round on the top; the corners were perfectly sharp and clean, and it was laid again. It would not have been taken up at the time he referred to but for the

making of the tramways. As to rolling macadamised roads with a steam roller, he had had a good deal to complain of in Newcastle. He had struggled with it very hard, but he could not get his own way always. He had endeavoured to get the men to put the metal on dry. This was an improved method. The metal should be put on perfectly dry, 6 or 8 inches deep, and then the steam roller passed over it three or four times, until the stones presented a flat surface on the top. Then sand and water put on, and well worked into the interstices, and they had the road ready. But at present the custom prevailed in some places of substituting the mud scrapings from the pavement for the sand, the result being a hodge-podge sort of road when finished. This latter was the most expensive system in the end, inasmuch as, in either wet weather or in dry, the loose material on the road was lifted by the horses' feet or the wheels of the vehicles, and ruts were left which loosened the macadam and quickly put the road out of repair again. It was costly also, on account of the extra scavenging needed, and it was injurious to the public because of the amount of dirt that was thrown among shopkeepers' wares. They ought all, as far as possible, to insist on the improved system he had described being carried out; and if they failed, they ought to have their recommendation entered upon their minutes, so that the responsibility of the inconvenience and injury resulting from the neglect of their advice might not rest upon them. If they had amateur engineers on their public bodies they could get little or nothing done towards reducing the cost of these works. As to scorise bricks, he thought they could be broken up and used again for bottoming a macadamised road. Four inches of scorise bricks used in this way, then 4 inches of whinstone or broken granite, would make a good road. He was then designing some roads with 4 or 6 inches of broken slag, and 6 inches of metal on top of that, placed on a foundation of penning 8 inches deep.

MR. G. BELL: With reference to the steam rolling, some months previously I was in London, and in a very wide street I saw two heavy rollers and one small one at work. In that case small gravel was spread on the tops of the stones and rolled in dry, and when that was done there was a most beautiful road.

MR. HUBERT LAWS: With the permission of the Members, I

should like to make a few remarks on some of the points raised. I quite agree with there being a concrete foundation for a paved road; the firmer and harder it is, the better. I am doubtful whether the same principle will apply to a macadamised road. I have seen roads made with a pitched foundation, or with a foundation of smaller material, afterwards covered with a hard material. These have been most excellent roads, quite equal, I think, to any paved street. I doubt whether 5 or 6 inches of hard material, on the top of a hard surface of concrete, would have sufficient elasticity. I believe, however, that the whole essence of macadamising lies in the breaking of the stones, and I would have the stones no larger than would go into a man's mouth. I was surprised to hear that it was the experience of some of the Members that granite wore smoother than whinstone. I am under the impression that the reverse is the case. At the same time, I much prefer whinstone to granite. Fortunately, in this neighbourhood we are favoured with a class of whinstone which is very coarse in texture, and does not wear so smooth as that of other districts. The great objection to concrete foundations, as referred to by Mr. Thomson, is the inconvenience in reaching gas- and water-pipes. It is inconvenient to companies who have to keep the pipes in repair, and when broken up, very annoying to the engineers who have charge of the roads. Some years ago it was suggested that a subway should be made for the purpose of holding the pipes, but the difficulty was that they could not have a water-pipe in a subway with a sewer and a gas-pipe. But for that, I believe such a system of subways would have been generally adopted. The great expense which double subways for water-pipes and sewers and gas-pipes would involve had caused the project to fall out of favour. Asphalte has been referred to as a means of binding sets and making the roads waterproof. I should like to know whether any gentleman, instead of grouting their sets with lime, has ever tried a Portland cement grouting, and whether it would not act equally as efficiently as pitch. I am aware that there is less elasticity, and possibly that is a serious disadvantage. But a cement grouting would be cheaper than pitch and tar, and it would also have the advantage of not running out at the joints, as pitch did in hot weather. I have seen cases of very excellent streets where the pitch, that had run from the centre of

the street into the gutter owing to the heat, lay to the depth of an inch or more.

The CHAIRMAN, in reply to the query respecting Portland cement as compared with asphalte, said that Portland cement, in the course of time, would disintegrate. It was brittle, and if it once cracked it could not be made good again. Asphalte varied with the weather. In very cold weather the joints were perfectly tight, and in hot weather, if it had been put in by skilled men, it did not run out, but adjusted itself. As to the subways, the reason they had not been introduced was, he believed, owing to the expense.

Mr. JAMES HALL, replying to the comments, said, with reference to the remarks of Mr. Hall, of South Shields, on the size of sets, he thought 4-inch by 7-inch sets were very good; but he considered 3 or 3½-inch, especially where there was a steep gradient, much better. As to the depth, he had seen cases where they used granite sets with a depth of fully 10 inches. This, too, was done in a street where the traffic was comparatively light. The advantage was that when the sets had been worn down to a certain extent in a principal street, they could be removed to a second-rate street, and by repetitions of this process a great deal was saved. He did not think it an over-statement to fix the life of a pavement at from twenty-five to thirty years, if the pavement in the first instance was really properly put upon a good foundation, and with a narrow joint. As to scorix bricks, he had used spoiled ones as macadam with a great amount of satisfaction; but they must remember the essential difference between a scorix brick and a piece of whinstone—the latter had all its natural life in it, the former had not. Scorix bricks were not so cheap as whinstone, when the carriage was to a distance, because there were not so many yards to the ton. With reference to Mr. Rounthwaite's remarks about broken whinstone and broken granite, he might say that when he was assistant surveyor at Tynemouth they used to get a large quantity of whinstone, and his experience had been that they had never got so good a road from granite as from whinstone. He did not believe in 1½-inch broken stone. He thought 2 inches was just as little as they should have it, and, where they had a steam roller, 3 inches was the proper thing. A 1½-inch cube could not be expected to bear the same amount of weight as a 3-inch. The

smaller the stone the more liable was it to be crushed. As to steam rollers, there was not the slightest doubt but they affected the piping. The first time he used it he extinguished a whole street of lamps, and broke a great many water-pipes. But if the water companies and gas companies would not put their pipes down sufficiently, why should the public be kept from having good roads? He had gone thoroughly into the question of the steam roller, and had found it to effect a saving of 30 per cent. per annum on the cost of maintenance for streets. As to random pavement, spoken of by Mr. Rounthwaite, 4s. per yard was very cheap; but when they considered that they could make a real good block pavement for 5s., including an excellent foundation, he thought they might as well have it instead of random pavement, which at the best was not perfect. With reference to Mr. Laws' statement about a concrete foundation for macadamised roads, he had had some experience of concrete foundations, and he thought it was just as good and as useful, if it was not too expensive, in a macadamised road as in a paved street. For this reason, in any description of road, he contended that the covering they put on was merely a protection for the foundation, and if they put a layer of gravel or ashes between the concrete and the covering of the foundations, they were bound to get a splendid road, with a good foundation, and the weight distributed over the whole surface.

On the motion of Mr. M. HALL, seconded by Mr. G. BELL, a hearty vote of thanks was accorded the author of the paper.

The next business was the following paper :—

WOOD PAVEMENTS.

By R. S. ROUNTHWAITE, BOROUGH SURVEYOR, SUNDERLAND.

THIS subject has been selected by the author with the view of offering for consideration a few remarks on wood paving generally, and with especial reference to this class of pavement as recently laid down in some of the principal thoroughfares of the borough of Sunderland. A brief description of this form of roadway is given, as the author believes Sunderland has indulged in it to a greater extent than any other town in the North of England, having now nearly two miles of roadway laid with wood blocks. It is to be hoped that criticism will be full and complete, for more is learnt from good-natured criticism than can well be estimated.

The first experiment, on a small scale, with wood paving was made on the Wearmouth Bridge in 1859 and this was replaced in 1867. On both of these occasions the material used was unpreserved redwood, except in three small portions, where trials were made with narrow strips of creosoted red pine, creosoted beechwood and unpreserved oak. A strip of creosoted red pine 6 feet wide was laid from side to side of carriageway (about 24 feet), a strip of creosoted beechwood 3 feet wide and a strip of uncreosoted oak 6 feet wide. In 1877 this roadway was again renewed, and the former experiments having shown that the *creosoted* wood suffered less from wear and tear than that which was *unpreserved*, the whole was done with *creosoted* red pine, except the strips of creosoted red pine, the oak and the beech blocks; the strip of red pine was left untouched, the strip of oak was turned and relaid upon its original face, and the beech was merely raised.

In the latter end of 1873 the south approach to the Wearmouth Bridge (Bridge Street) was paved with creosoted redwood blocks, varying from 4 to 5 inches in width. These blocks were chamfered at the joints $\frac{3}{8}$ ths of an inch on the top and $\frac{1}{2}$ an inch on the side, and were 6 inches in depth; the foundation was formed of Portland cement concrete about 9 inches in thickness, and the courses of blocks were kept apart by laths at least $\frac{1}{2}$ an inch thick. It will thus be seen that, with the lath and chamfer together, the joint

was not less than $1\frac{1}{2}$ inches wide on the surface. It was thought that this description of joint would render a better foothold for horses, the street in question having a gradient towards the bridge of 1 in about 40. This pavement has been down upwards of *seven years* without requiring any repairs, but it is now evident, from the experience acquired, that this description of joint is anything but satisfactory. When the Sunderland Tramways Company laid their rails in this street a good opportunity was offered for definitely ascertaining the wear and tear, and the author need not say that this opportunity was fully taken advantage of. No less than 1727 measurements were taken, which showed the average wear to be $\frac{9}{16}$ ths of an inch; the greatest amount of wear was 1 inch and the least $\frac{1}{8}$ th of an inch. These figures apply to the centre portion of the roadway for a width of 16 feet, and show, very clearly, the condition of the pavement after a life of *five years*. The traffic in this street is as heavy as that in any other street in the town, but the author regrets not being able to lay before you some more definite information as to the number of tons or vehicles per day.

Fawcett Street, a continuation of Bridge Street to the southward, and practically level, was (with the exception of a small portion at the north end) paved with creosoted redwood blocks in the year 1876. The foundation was of Portland cement concrete; the blocks were 6 inches deep and from 3 to $3\frac{1}{2}$ inches wide; the joints in this case were not chamfered, but merely kept apart by creosoted laths. The same opportunity was here offered, through the operations of the Tramways Company, for ascertaining the wear, and it was found to average about $\frac{1}{4}$ of an inch, the greatest wear being $\frac{3}{8}$ ths of an inch and the least $\frac{1}{8}$ th of an inch. The length paved was about 295 yards.

High Street West, one of the main business thoroughfares in the town, was paved in a similar manner to Fawcett Street in the year 1877, and though, in the early part of last year, the Corporation laid down a line of tramway in this street, no measurements were taken to ascertain the amount of wear; but previously to this time three places were opened up for the purpose, and it was found to range between $\frac{1}{4}$ and $\frac{5}{8}$ ths of an inch. The total length of this street then paved with wood was about 400 yards.

In laying down their rails in Borough Road, Holmeside and North Bridge Street, the Tramways Company paved within their rails, and for a distance of 18 inches on either side, with creosoted

English beechwood blocks, 5 inches deep and 3 inches wide, on a foundation of Portland cement concrete 6 inches in thickness. The Corporation, during last year, finished the remaining portions of these streets with creosoted *redwood* blocks, of the same size, and laid in a similar manner.

A further portion of High Street West, as far eastward as Villiers Street (a length of about 477 yards), has also, during the past year, been paved with wood, the blocks between and immediately outside of the tram rails being laid with beechwood, and the remainder with redwood.

Hendon Road, for a length of 275 yards, has also been laid with wood during 1880. In this case the blocks varied from 3 to $4\frac{1}{2}$ inches in width, and from $5\frac{1}{4}$ to $5\frac{3}{4}$ inches in depth, being, for the most part, those which had been taken up from streets through which the tramways have been laid. These blocks were thoroughly cleaned of all old pitch and reversed, and have made a very excellent carriageway; they were laid on a foundation of Portland cement concrete, 6 inches in thickness, and bedded on about $\frac{1}{2}$ an inch of sand to adjust the inequalities in the depth of the blocks; the blocks were sorted, so that the courses should all be of an uniform width; the courses were kept apart by means of creosoted redwood laths $\frac{3}{8}$ ths of an inch wide and 1 inch deep. The joints were then run with pitch and gravel, and fine pea gravel rolled into the surface. This work was executed by Mr. John T. Simpson, of Newcastle-on-Tyne, at a cost of 5s. 7d. per superficial yard. Only a very small portion of this road was laid with *new* blocks and these were put down in the narrowest part, where the traffic would be more concentrated. The total area paved was about 1500 superficial yards.

A part of New Union Street and Back Fawcett Street, immediately adjoining the New Central Railway Station, is also paved with wood in a similar manner to those streets already mentioned, but this work was executed by the North-Eastern Railway Company, the Corporation bearing one-half of the expense.

Having now briefly described the streets and roads within the borough which have been paved with wood, and the manner in which they have been done, alluding also to the wear and tear of those which have been down any length of time, the author will proceed to give more fully a description of the manner in which that portion of work done during the past year has been executed. The first thing to be referred to is the *excavation*,

which is taken out to a depth of $12\frac{1}{2}$ inches below the level of the proposed finished surface of roadway, and the earth is then well watered and punned if necessary. The next and *most important* part of the work is the foundation; this is formed of Portland cement concrete, gauged in the proportion of *one* of cement to *five* of clean ballast, or hard stone broken to pass a 1-inch ring, and *one* of clean, sharp sand; this is turned over dry and thoroughly mixed on a wooden platform; the water is added from a rose in sufficient quantity only to make the ingredients cling together, and the foundation is then laid in position to a depth of 6 inches and finished, with a smooth and even top, $6\frac{1}{2}$ inches below the proposed surface of paving. The concrete is beaten down with the shovel, or broad wooden beaters, until the moisture rises to the surface. The cement was subject to the usual tests, viz.:—

1st. That the weight per struck imperial bushel should not be less than 112 lbs.

2nd. That a briquette, after being immersed in water for *seven* days, shall bear a tensile strain equal to 250 lbs. to the square inch.

3rd. That it must pass through a sieve of 1500 meshes to the square inch, leaving a residue of not more than 10 per cent.

After the concrete has been allowed to set for about forty-eight hours, a thin bed of sand, not exceeding half an inch in thickness, is spread over the surface, and the paving is proceeded with.

The blocks are of the *best* description of Baltic redwood, thoroughly well seasoned and free from all sap, shakes, large and loose knots, or other defects. Memel or Dantzic timber is preferable to Riga, on account of the stronger and tougher nature of the former. The blocks vary from 6 to 12 inches in length, and are cut from imported deals or balk timber, but more generally from 11-inch by 3-inch deals or planks, which allow for $2\frac{1}{2}$ inches of sap being sawn off on either side. The width of the blocks is 3 inches, and the depth 5 or 6 inches (preferably 6 inches); they are laid with the fibre of the wood vertically, on *not more than half an inch* of clean, fine sand, to adjust any inequalities in the depth of the blocks, or in the concrete foundation; the butt joints are laid close, and the courses kept apart $\frac{3}{8}$ ths of an inch by means of creosoted laths 1 inch deep by $\frac{3}{8}$ ths of an inch thick.

The wood is preserved with creosote of the best quality; it is placed in the creosoting boiler, and the oil forced into it by means of steam power at a very high pressure. Each cubic foot of timber is required to absorb not less than 10 lbs. of creosote oil, but this

has usually been much exceeded. The blocks are weighed before and after they are subjected to the process.

The author is aware that blocks have been recently used in Newcastle-on-Tyne and in Regent Street, London, without undergoing this process of preservation, but he is strongly of opinion that they will be found to endure a very much shorter time than preserved wood; the creosote will effectually keep away or destroy all organic life, and will, moreover, tend to lessen the effects produced by alternate wet and dry weather.

The Tramways Company have used creosoted English beechwood in preference to red pine, as being harder and more durable, and therefore less expensive to maintain, though perhaps rendering a somewhat less foothold than a softer description of wood. The beechwood is very much more porous than either Memel or Dantzic, and costs about 1s. per yard more.

After the blocks are laid in position on the sand bed, and properly adjusted with template to the required camber, the joints are partly run with good soft pitch reduced to a proper consistency by mixing with creosote oil (about *one gallon* of oil to the cwt. of pitch); they are then partly filled with fine gravel, again run with pitch, further filled with gravel, and finally run with pitch. After the grouting is completed, a thin coat of fine gravel, or grit, is spread over the surface and rolled in with a horse roller. This gives an extra foothold, and tends to preserve the wood from abrasion.

The channels for surface water are, for the most part, formed of one course of Inverkeithing or Northumberland whinstone; the stones are 9 inches wide, 5 inches deep, and not less than 12 inches in length; they are bedded on a foundation similar to that on which the wood is laid, and are grouted with cement.

Almost the whole of the wood used in the works referred to herein has been supplied by Messrs. Armstrong, Addison and Co., of this town, and a great portion has also been laid down by the same firm. They make a speciality of this description of work, and take great care in the selection of the wood, which is the first and main object to be aimed at.

In conclusion, the author would again refer to the importance of a solid and well laid foundation, for without this a good road surface will never be obtained, and the life of *any* pavement will be materially shortened.

Some question may probably be asked as to the comparative

safety of wood and granite pavements, and the author must confess that at one time he had very grave doubts that the former would prove more dangerous than the latter, but, by reason of having frequently to drive over wood and every other description of pavement, and also from recent observation, he has formed a somewhat different opinion. If the wood be properly laid, with comparatively *close joints*, and if it be kept *scrupulously clean*, there is no reason why it should be more dangerous than granite sett paving. The statistics issued by the Surveyor to the City of London clearly establish the fact that the wood pavement is *safer* than granite. The author would, however, lay great stress upon the necessity of having it kept in a *thoroughly clean* condition, and of laying the courses as closely as possible, for wide joints only serve to accumulate dirt, which soon becomes dangerously greasy. If the blocks are only 3 inches wide, a space of $\frac{1}{8}$ ths of an inch between each course is quite sufficient.

It is also to be borne in mind that with a wooden pavement the wear and tear to both horses and vehicles is greatly diminished. Every driver knows well how a stone pavement tells upon a horse, and especially one that is driven all day in a tradesman's van or a dog-cart.

Another advantage a wood pavement affords, is the comparative freedom from *noise*, which in a business thoroughfare cannot well be estimated.

It has been calculated that whereas *four* loads of mud are taken from a macadamised roadway, and *two* loads from a granite pavement, not so much as *half a load* is taken from the wood.

The cost per superficial yard for creosoted redwood blocks, laid in Sunderland as hereinbefore described, is about 12s., and beechwood about 13s. These prices are, of course, dependent upon local circumstances, such as the nature of excavation, distance of tip for same, &c.

DISCUSSION.

MR. M. HALL: I wish to know the number of years the Local Government Board will allow them to borrow upon wood pavements.

MR. GEORGE BELL: The quantity of creosote absorbed depends on the quality of the wood.

MR. J. HALL: I should like to ask whether the author considers it necessary to creosote English beechwood, or English oak—beech-

wood particularly. In my opinion to creosote beechwood is simply a waste of money.

The CHAIRMAN: The introduction of wood pavement into a large town is, to my mind, a great sanitary improvement, inasmuch as it deadens the sound of vehicular traffic. It also, to a great extent, diminishes dust and dirt in the streets, but I think the advantage gained in lessening the noise is really the most important. The shopkeepers in and about the Strand petitioned for a wood pavement on that account, and I know from my own experience in Leeds, where they have paved Commercial Street with wood, that it has been a great boon to the shopkeepers. That street is laid on the improved wood pavement principle, which consists of making a foundation of two courses of planks laid diagonally. Bartholomew Lane, in London, was paved on the same principle, and I do not know that it has ever since required repaving. I believe that was the first time a wood pavement had been laid in the new style in London. There are several systems of wood pavement of which the paper does not treat. It deals only with the Sunderland system, and perhaps the Sunderland system was as good a one as existed. I am glad to observe that they had run the joints in with asphalt, for I consider that the very essence of securing a good street surface. The paper gives a description of the different kinds of timber used in Sunderland, but said nothing of pitch pine. That wood is very hard, but it varies a great deal in texture, and contains a considerable amount of resin. In Newcastle, much against my wish, people had laid down this pitch pine pavement. You all know that pitch pine laid on damp places rots sooner than perhaps any other timber. This was due to the resin, which made the wood very subject to changes of temperature. Moreover, that in Newcastle was laid on a concrete foundation, in connection with the tramway, and in lime grouting. You know that timber expands and contracts with the weather, and that lime grouting will not adjust itself to it. The consequence is, that the water will get into the joints and seriously affect the pavement. I think the first thing you ought to settle in your minds is the class of timber—whether elm or redwood. I believe redwood to be an excellent timber. The Baltic timber is more even in quality and weight, and you all know that if you have a variation in the weight or quality of any material in a street it tends to set the whole street out of order. Beyond that, you have a great

sanitary object to look at, and that is the accumulation of dirt on the surface, and the wear and tear on vehicles and horses. Between a wood pavement and the round-topped granite pavement there is no comparison whatever. If you could get a comparison of cost for wear and tear of vehicles and horses on a wood pavement and on a stone pavement, the difference, I am sure, would be enormous. You have, however, to take into consideration the cost of wear and tear of wood pavement. You know that many companies require 1s. per square yard per annum to keep it in repair, and I think I would fix the life of a wood pavement in a thronged street at about six years. Now, if wood pavement cost 17. per square yard, in round numbers, and 1s. a year to keep it in repair, there was an expenditure of 5s. or 6s. per annum. That, however, was to be set against the great advantages I have mentioned.

Mr. THOMSON: Am I right in saying that either Boar Lane or Briggate, Leeds, was paved in the manner you describe and had in a short time to be laid again with a concrete foundation, as recommended by Mr. Rounthwaite?

The CHAIRMAN: I think the pavement was there two years before I left, and I have heard nothing about it being taken up.

Mr. HALL: In Briggate, in Leeds, last year I saw them relaying the roadway and tramways, and they had a concrete foundation.

Mr. H. LAWS: As far as I can recollect, with regard to the laying of wood pavements on diagonally set planks, I imagine they put a concrete foundation under these planks. With regard to the qualities of timber, there can be no doubt Memel redwood is the most uniform in texture, and that is what is wanted in making a roadway. You want timber which will not wear into a hole here and a round knob in another place, and that will be best attained with Memel redwood. I was surprised to learn from the paper that so much creosote could be got into timber. I am very well content if I can get 8 lbs. into a cubic foot of timber. With respect to creosoting beech or hardwood, I do not believe it would add anything to its power of resisting rot from moisture. I believe it would add considerably to the value of redwood in assisting to make it impervious, and thus to prevent the moisture from going through the surface and down to the foundations, which is a very essential matter for the welfare of a road. I highly commend the plan which has been followed in Sunderland, of noting carefully the effect of wear and tear upon the pave-

ment. I would urge upon all engineers and public bodies to classify their experiences in a similar way.

Mr. ROUNTHWAITE, in replying, said, with reference to the cost of wood pavement, the cost of 12s. or 13s. given in the paper meant the cost for pavement, foundation, gravelling, excavation, and everything complete. They had had contracts at from 11s. 3d. to 12s. 3d., but he thought 12s. a fair price for the work, that was to say with redwood. With regard to the life of the pavement, he thought the experiment made on Wearmouth Bridge from 1859 to 1870 scarcely a satisfactory trial. They could not really judge of a pavement of any kind laid down 6 feet wide. A more considerable surface than that was required. But Bridge Street, which was laid in 1873 or 1874, had now been down seven years, and had not been repaired at all; and he might say that at the time it was laid very much less care was taken in selecting the blocks than was done now. These were only very slightly creosoted, and chamfered, and they were laid with a joint $1\frac{1}{4}$ inch wide, which caused them to wear much more unevenly than they would otherwise have done. Moreover, the street had a considerable gradient; and he asked them whether, if wood so creosoted, so selected and laid, would last seven years without repair, was he not justified in assuming that if properly creosoted and laid it would last, with repair, twenty years? As to borrowing, the Local Government Board had never given them power to borrow for more than fifteen years; they had asked for twenty years, but were refused, because the pavement was comparatively new. With reference to creosoting, blocks were cut up into proper sizes of 6 inches by 3 inches, and 6 inches to 12 inches long. The average amount of creosote put into each cubic foot was no less than 14 lbs. Beechwood, which was more porous and harder, had had put into it as much as 20 lbs. per cubic foot. He was of opinion that every sort of timber ought to be creosoted, if only as a sanitary measure. He remembered seeing in London some years ago a pavement on the improved system referred to by Mr. Fowler, or something very like it, taken up in Orchard Street. He believed it had proved a failure. That was not surprising, as it made the road very elastic, so much so as to crack the asphaltic joints, and allow the water to get in to the foundation, whereby the road was ruined. In the Strand, four or five years ago, the pavement was laid with a concrete foundation, and he was not aware that it had been renewed yet. The traffic there was certainly very heavy.

The CHAIRMAN remarked that the foundation in the case referred to sometimes was of concrete with planks, and sometimes without planks.

Mr. ROUNTHWAITE had had no experience of pitch pine, but thought it was not so good as Memel timber, on account of being too resinous.

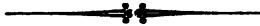
On the motion of Mr. THOMSON, seconded by Mr. HALL (Stockton), a vote of thanks was passed to the author of the paper.

The company then inspected the works of Messrs. Smith, Patterson, and Co., sanitary ironfounders; Messrs. Douglas Brothers' ironworks; and Messrs. Harriman and Co.'s pipeworks. Afterwards they partook of luncheon in the Station Hotel, Lieut.-Colonel Cowen occupying the chair, and this brought the day's proceedings to a close.

DISTRICT MEETING AT HANLEY,

May 13th, 1881,

Held in the Town Hall, Hanley, Mr. E. PRITCHARD, Past President and Hon. Secretary of the Midland District, in the absence of the President, occupied the Chair.



THE Members having assembled, Mr. Pritchard was re-elected Hon. Secretary for the Midland District for the ensuing year.

The Members were first shown the Hanley Sewage Works, and inspected the pumping engines, precipitating tanks, and intermittent filtration areas; and then visited the principal storm leap-weirs at Etruria Vale; the Tramway in process of construction through Hanley; and afterwards the Public Baths, &c.

THE HANLEY SEWAGE WORKS.

By JOSEPH LOBLEY, Assoc. M.I.C.E., BOROUGH ENGINEER.

THE borough of Hanley contains a population exceeding 48,000, on an area of 1768 acres. The town is situated on a hill, the highest point being 643 feet above Ordnance datum, and 284 feet above the lowest surface level in the borough. The market-place is at a level of 170 feet above the sewage works.

The principal sewers, following the course of the old water-courses and main roads, have generally steep gradients. In numerous instances where the inclination of the ground is great the sewers have been constructed with a less severe gradient, with risers at manholes, in order to check the rush of water downwards.

These sewers discharged their contents, at numerous points, into the Trent on the one side, and on the other side into the Foulea Brook, a tributary of the Trent.

There are some brick sewers, but for the most part they are

stoneware pipes laid in straight lines, with manholes at junctions and at every change of line, or gradient, and with open ventilation at manholes and at intermediate lampholes.

The Trent and Mersey canal passes through the borough, and is joined at its summit level by the Caudon canal. These, together amounting to four and a quarter miles, form contour lines almost round the town. Every main outfall sewer of the town passes under the canal; the total number of such crossings being sixteen.

Owing to the undermining of large areas of the borough, the canal banks are defective in many places, and the work of putting the sewers underneath, and preventing percolation from the canal, has been somewhat arduous. The total length of main sewers is twenty-one miles.

The subject next requiring attention is that of the disposal and purification of the sewage. Separate works at each outfall had the attention and support for a long time of the local authority. After careful consideration, this idea was reduced to two sets of works—one for the Trent outfalls, and the other for the Foulea Brook outfalls. Eventually this gave way to one outfall situated at Trent Hay Farm.

At a point opposite this farm, the eastern intercepting sewer commences, and is constructed along the Leek Road to near the borough boundary at Bucknall; its sizes are 3 feet 6 inches by 2 feet 4 inches; 3 feet by 2 feet; 2 feet 6 inches by 1 foot 8 inches; 15-inch circular and 12-inch; and gradients 1 in 1300, 1 in 265, 1 in 214, and 1 in 200. A branch intercepting sewer is carried along the Ivy House Road to Keelings Lane.

Although the most populous portion of the town lies at a considerable elevation above the works, it will be seen that large districts, rapidly increasing in population, are upon comparatively low levels, and that the ground traversed by the intercepting sewer does not allow of such good gradients as might be desired.

Where the intercepting sewer passes under the main sewers from the town, manholes containing valve weirs are placed, so that in case of excessive rainfall from thunderstorms the water will leap over the valve and pass on to the river by storm culverts. At other times the water descends through the open valve into the intercepting sewer beneath.

The parts of the town lying below the level of the Caudon canal contour line, as well as new neighbourhoods elsewhere, are being drained on the separate system; one sewer for sewage

and one drain for rainfall. This system can be extended as may be found necessary.

The northern intercepting sewer commences opposite the farm, and is carried by way of Leek Road, Caudon Road, Cemetery Road to Etruria Vale, and there intercepts the principal main sewer of the borough, originally the Boothen Brook. It continues its course, passing under the canal onwards to Etruria Village. Its sizes are 3 feet 6 inches by 2 feet 4 inches as far as the vale, and 15 inches and 12 inches onward to Etruria; and its gradients 1 in 666, 1 in 400, and 1 in 300. The depth at which it is constructed below the surface of the ground steadily increases from 13 feet to 50 feet, then decreases to 7 feet at its termination.

At Etruria Vale a branch of this sewer has been constructed under the canal at a point where it is in artificial ground across a valley. This was required to intercept the Sun Street sewer, and was carried out without requiring the canal to be emptied, or stopping the traffic on it.

This branch was constructed in the following manner: a sewer 5 feet by 3 feet 4 inches inside, in 14-inch brickwork in cement, was first made with flat invert; in the bottom of which were laid 20-inch stoneware pipes, surrounded with Portland cement concrete. Over the pipes an invert was made in concrete for the top portion of the sewer, the whole forming two separate sewers, one of 3 feet diameter, the other one of 20 inches. At the upper end of this double sewer a manhole with leap-weir valve is made, storm waters taking the top course, ordinary flow the bottom. At the lower end these diverge, the one leading to brook, and the other being connected with the northern intercepting sewer.

At the point where the Etruria Vale main sewer is intercepted, a double leap-weir arrangement has been constructed, with chamber, ventilating tower, and entrance of larger dimensions than elsewhere.

At this spot the junction of the canals, the aqueduct across the valley scarcely perceptible now, the numerous locks, the intercepting sewers at depths from 50 to 26 feet, the storm overflow leap-weirs, the sewers under two canals, and the gasworks, all within a radius of 200 yards, render this a somewhat remarkable locality.

The total length of intercepting sewers and storm overflows is six miles, making, with the main sewers, a total of twenty-seven miles; a few of which remain to be constructed.

The eastern and northern sewers unite in one outfall, 3 feet 9 inches diameter at the farm, which discharges its contents at all times free and unobstructed, and during all condition of river floods ; but, in order to effect this, the lower part of the Etruria and Cliff Vale, containing not more than two hundred dwellings lying at a very low level, have been left out of the collection.

These localities will require to be exceptionally treated. The author stated at the Wrexham Meeting, with reference to Mr. Shone's pneumatic ejector, that he fully expected it could be advantageously used to lift the sewage of these localities into the intercepting sewer.

Another plan would be to construct a sewer along the valley and join with the Stoke sewers by arrangement. Many other plans have been suggested, and it will resolve itself into a question of comparative cost. At present the sewage, from a population under 1000, is being used in irrigating neighbouring fields.

The Sewage Disposal Works.

The sewage works are constructed at Trent Hay Farm ; within the borough boundary and adjoining the river Trent.

The Corporation first acquired 9 acres by compulsory powers, and subsequently this was increased to 23a. 1r. 7p., which cost 12,340*l*. The acquisition of sufficient area for an irrigation farm was deemed impossible, the surrounding land being all regarded as building land. Thus the Council were compelled to rely upon treating the sewage by precipitation in tanks, followed by intermittent downward filtration, before discharging it into the river.

The works consist of reservoirs to receive the sewage during the night and on Sundays, engine and boiler-house, lime-mixing house, four precipitating tanks, sludge-pumps and beds, and 20 acres of land for filtration.

The old farmhouse has been divided into two dwellings for workmen, and the old farm-buildings are used as store-houses and lime-sheds.

The Reservoirs.

The reservoirs taken together are capable of holding one million and a quarter gallons, and are 200 feet long by an average width of 188 feet, depth 5 feet to 8 feet, and are subdivided to facilitate cleansing.

The sewage passes first into a small catchpit, in which the stones and heavy matter are collected ; from thence (in the night) into the first division, after filling which it flows over into the second division, and so on into the third, and, if necessary, through long continued rain during the night, a final overflow conducts it to the low-level filtration areas.

In the daytime, during treatment, the sewage passes direct from the catchpit through a screening chamber to the pump-well.

The Pump-well.

The pump-well is situated adjoining the engine-house, being placed outside in order that the interior of the buildings should be free from sewage odours. It is subdivided by a wall with penstock, and is in direct communication by culvert with the screening chamber opposite the mouth of outfall sewer, and with each of the reservoirs by means of 15-inch pipes ; also from the bottom of a sluice-chamber by means of an 18-inch cast-iron pipe. Into this sluice-chamber the contents of any of the reservoirs can be directed as may be desired.

All these various channels are provided with sluices, in order that the sewage can be directed into first or second reservoirs at will, or either or both reservoirs can be emptied by the pumps in addition to the coming sewage.

A pulsometer steam-pump, with 4-inch delivery, is fixed in the well, by means of which the slush from the bottom of the reservoirs can be lifted out. It is also available for entirely emptying the well, in order to clean the screens which are placed in front of the suction pipes of the large pumps.

The Engine-house.

The engine-house, measuring 33 feet by 22 feet, contains the following : Horizontal steam-engine, with cylinder $11\frac{1}{4}$ inches diameter, and 20-inch stroke of piston, provided with variable expansion gear, working a centrifugal pump by means of belting.

The speed of the engine is 90 revolutions per minute, and that of the pump 333.

The suction from pump, enlarged gradually from 15 inches to 21 inches diameter, descends by means of curved pipes of large radius in pump-well.

The water discharged passes through forty-eight 3-inch brass tubes enclosed in a surface condenser, and onwards by a 15-inch delivery pipe to a conduit leading to the precipitating tanks.

An air-pump, worked from the end of fly-wheel shaft of engine, is in communication with the condenser, together with the exhaust steam from the cylinder, a steady vacuum being maintained equal to 13 lbs. on the inch.

The whole of the above is in duplicate, and each pump can work with or without the other one, and can pump out of either reservoir or from level of outfall sewer as may be desired.

Each pump is capable of lifting 4000 gallons per minute 12 feet high, that is, from the medium level of the reservoirs. The top level of the reservoirs when full is that of the invert of outfall sewer, from which the lift is 8 feet. Upon emptying the reservoirs, the last water pumped would be lifted 16 feet. The speed of the engines remaining the same, the amount of water pumped varies inversely to the height lifted.

This room also contains a vertical engine, with 6½-inch cylinder, to drive the lime-mixing machinery in the lime-house. This is also a condensing engine, the exhaust steam being turned into either of the condensers at will.

The Boiler-house.

The boiler-house measures 34 feet by 19 feet 6 inches, and contains two Lancashire boilers fitted with Galloway tubes. Each boiler measures 22 feet by 6 feet 6 inches.

A well has been sunk outside adjoining the building, from which water is lifted by means of a direct-acting steam-pump, for the purpose of feeding the boilers, and filling a cistern placed above ceiling of fitting-shop.

This shop, and a spare room, each 15 feet by 10 feet 6 inches, are situated between engine- and boiler-houses.

The chimney stack is 70 feet high, octagonal in shape, on a square base. Messrs. Tangye Brothers of Birmingham were the contractors for the whole of the engineering work in engine-room and boiler-house.

The Lime-mills.

Beyond the engine-house is the lime-room, 22 feet square, in which are placed two of Messrs. Bowes Scott and Read's lime-

mills. These are worked by belting from the small vertical engine, and supplied with water from the delivery of the centrifugal pumps. The lime is stored in the old farm-buildings, and is there slaked and screened and conveyed to the lime-room in galvanised iron boxes, each containing 28 lbs., which are emptied into the mill at stated intervals.

Each mill is a cylinder of cast iron, surmounted by a revolving cover, which forms a rubbing surface with top edge of cylinder. Agitators inside revolve with the cover.

The lime is put in through the hopper at the top, and when mixed with the water it passes through the rubbing surfaces (a headway of water inside being allowed) in a fine state of division; and is conducted to the pump-well, where it is delivered into the sewage water immediately opposite the ends of the suction pipe of either centrifugal pump, as may be required. No lime settles in the well, as the current is too strong. Upon the stoppage of the pump, the supply of milk of lime ceases automatically, as it depends on the water being duly furnished to the mill from the pump delivery.

The mills can be supplied with water from the cistern when requisite.

A Korting's steam ejector is used to exhaust the air out of the centrifugal pumps in order to commence pumping, thus dispensing with charging them with water from a cistern or other source.

The Precipitating Tanks.

The precipitating tanks are four in number, each being 200 feet long by 30 feet wide, and depth varying from 3 feet to 7 feet. They are capable of holding 810,000 gallons. The combined sewage and lime is discharged into a conduit on the tank walls, in which are placed obstructions to break up and agitate the flow as much as possible. From this conduit the sewage is admitted into any of the tanks as may be desired. Generally all four tanks are being used, in which case the sewage is admitted into the first one, whence it flows through the other three successively, finally passing into a conduit leading to the high level filtration areas.

These tanks are designed on the principle of frequent cleaning out the sludge. During the night the supernatant water is drawn off from any one tank and conveyed to the middle-level filtration areas. In the morning, before commencing pumping, the sludge is discharged by gravitation on to filter-beds, and the tank swept out.

If conducted regularly in this manner, one tank each night and morning, this operation lasts but a few minutes, and no possibility can exist of an accumulation of sludge interfering with the proper action of the chemicals on the sewage passing through. With one pump working, the average time the sewage is passing through the tank is four hours, or that period is thus obtained for precipitation.

Practically, it exceeds this time, as two runs of five hours each in the twenty-four leaves the water standing in the tanks meanwhile for fourteen hours.

The advantages of pumping are considerable. It prevents the necessity of night or Sunday work ; it greatly assists in blending the sewage and lime together ; the stream being a regular one, the amount of lime can be easily regulated ; it enables the tanks being placed at a high level so that the sludge can be discharged by gravitation and the effluent water passed on to the highest levels of the farm.

The Sludge Beds.

The sludge beds are for the present simply areas of potters' schraff or refuse ; the water drained therefrom passes into a small catchpit, from which it is pumped when requisite by a pulsometer into the tanks. These beds are of a tentative character, and can be displaced with other arrangements if the resulting material can find a remunerative sale.

The High-level Filtration Areas.

These, when completed, will form twelve beds, each about one acre in extent ; they are underdrained 4 to 6 feet deep. It is expected that each bed will not require to be used more than one day in each week.

Owing to the recent construction of these parts of the works, and to the small amount of vegetation thereon, the water washes up the fine sand and becomes less clear than before. This time alone can remedy. It was not deemed advisable to delay opening the works when it was in the power of the Corporation to effect a great improvement in the water discharged into the river, although the degree of perfection aimed at can only be approached gradually.

The carriers from the tanks to the farm are 18-inch and 15-inch Stanford jointed pipes, the distribution valves being Doulton's 12-inch patent stoneware valves delivering into open carriers.

The effluent water-drains are 12-inch pipes, at right-angles to the river, and 200 feet apart. These drains diminish to 9 inches diameter at their upper end.

At right angles to these are 6-inch perforated pipe drains, 100 feet apart; and again at right angles to these are 4-inch perforated pipe drains, 18 feet apart: the subsoil is a gravelly earth, very hard and close in some parts, but, as a rule, suitable for the purpose. The soil on the low levels is a light loam about four feet deep, but in winter time it is subject to floods.

The Volume of Sewage.

The domestic water-supply of Hanley is estimated at one million gallons per day, but, even in settled fine weather, two to three million gallons are pumped daily through the tanks. A large amount of water is taken from the canal by manufacturers, and some of it eventually finds its way into the sewers. A still larger amount is pumped from the mines. The former contains clay, and the latter salts of iron, and there is every reason to believe that these substances act beneficially on the sewage; for when this water is coming in large quantity it is found that 5 cwt. of slaked lime to the million gallons is as effectual as a larger quantity.

There is of course the expense of pumping this water to be taken into account. It averages a million gallons per day.

One pump can compete easily with all water ordinarily coming down in working hours.

The two pumps combined can lift a million gallons in two hours, but such an amount has never come in that time since the opening on the 17th March last—the season being a dry one.

The Cost of the Works.

The entire cost is as follows:—

| | £ |
|--|---------|
| Main sewers | 25,000 |
| Intercepting sewers and storm overflows .. | 18,000 |
| Sewage works, including land | 21,000 |
| | <hr/> |
| | £64,000 |
| | <hr/> |

DISCUSSION.

The CHAIRMAN: The paper is not a lengthy one, but when you take into consideration the extent of the works, and the verbal explanations which have been given, you must look upon it as an important paper. I would invite you to put such questions to Mr. Lobley as will ensure replies, which are always given by Members of the Association who have carried out important works, and are willing to impart information which might not otherwise appear to have been made clear. I am sure Mr. Lobley will be no exception to the rule, and that he will give the Members full information with respect to this most important subject.

Mr. BOYS: I would ask what distance apart are the under-drains, the estimated cost per annum for pumping the sewage, the cost of constructing the filtration areas, and how the storm waters are disposed of?

Mr. GLEDHILL: I should like to know what quantity of water comes into the sewers from the manufactories, and the probable quantity of the domestic supply?

Mr. COMBER: What quantity of water is taken by manufacturers from the canal, and ultimately discharged into the sewers, and is it intended to place a restriction upon it?

Mr. MITCHELL: What is the dry weather flow of sewage which has to be dealt with?

Mr. CARTWRIGHT: I wish to say how much pleased I am with what I have seen to-day; although I have visited many sewage works, some of them of greater magnitude than those of Hanley, I have seen none with which I have been better satisfied. As Mr. Lobley stated, there are many advantages gained by the pumping of the sewage at first hand; there is the better mixing of the lime with the sewage in passing through the pumps, the greater command given over the filtration areas, and, more important still, the means to draw off the sludge from the tanks by gravitation. I should have been glad to hear how it is ultimately intended to dispose of the mud; this appears to me to be the most difficult, though generally the least understood, part of that most perplexing problem "Sewage Purification." It is possible, as we have seen, to produce an effluent water that will meet the requirements of the "Rivers Pollution Prevention Act," but the question how to satisfactorily dispose of the mud, remains unanswered. An

interesting fact in the Hanley sewerage scheme is the number of crossings over the canal, I should be obliged for some details as to the manner of their construction. I understood from the paper that there was a small area of the borough at too low a level to be drained into the present system. Will Mr. Lobley kindly tell us whether he has considered the applicability of Mr. Shone's Ejector to meet the requirements of the case?

Mr. ALLEN: I should like to ask whether the drainage is a separate system, or is the rainfall included in the sewage; also what is the depth of the gravel in the filtration areas?

Mr. HUGHES: I wish to know what is the relative quantity of mud daily flowing. The question which affects my district is the ventilation. I see surface ventilation is adopted at Hanley, and I should like to know how it answers.

Mr. WRIGHT: I should like to ask what is the cost per acre of the purchase of the land, the cost of the buildings and the tanks, and the laying out of the filtration areas?

Mr. PRICE: I should be glad of further information relative to the water from the mines and manufactories.

The CHAIRMAN: I think it is due to Mr. Lobley that I should express not only my personal thanks, but the thanks of all the gentlemen present, for what I may call a great treat, in a sanitary sense, that has been given us to-day. There is no doubt a wide field for sanitary engineering in the disposal of sewage. We have wise men advancing one theory, and wise men in another direction advancing something entirely different. Others again would adopt a process different from either; and yet I think, as sensible men, you must admit that there is no hard and fast line that can be drawn for every place. We must be governed by the peculiarities of the district and the nature of the sewage in determining upon the most approved and successful method of purification. As engineers, our first duty is to purify the sewage and improve the districts we represent, and this should be done in the most economical manner consistent with the construction of proper works for the purpose. The question of the utilisation of sewage must always take a subordinate position in the consideration of a system of sewerage. Mr. Lobley has given us a most able and lucid description of the Hanley Works, but perhaps some would not endorse all that he has said. I have my crotchet. I like to see tanks for subsidence and ground for filtration, and I should like to do that without lime. My reason for this, based on well

considered experience, is that in using any precipitate you increase that great bane to the engineer, the amount of sludge, which is so difficult to deal with. At the same time there is in this sludge certain refuse which requires a strong alkali, and that being so I have no objection to the principle in this instance. We have in Hanley a most remarkable work. The tanks appeared complete, and we have something like 20 acres of land for the sewage of 48,000 people, or 2400 persons for every acre. Mr. Lobley makes a sort of apology respecting the filtration areas, that the effluent water is not in such a bright state to the eye as it will be shortly. I can thoroughly endorse that; I can point to the fact that directly the sewage, which, though apparently clear, contains certain matters in solution, is turned on new land with freshly made drains, the effluent water appears turbid; but it is not with organic matter, for that has been removed. The land which we have seen this day has not had an opportunity of giving a clear effluent, but I am sure it will in a short time. You must accept the explanation that particles of fine sand find their way into the water; that will not be the case when the ground becomes solidified. The effluent from the precipitating tanks is very satisfactory indeed.

The question put by Mr. Boys as to the distance apart of the drains is a very pertinent one, and it is a matter which must be determined by the nature of the ground. With regard to the water discharged into the sewers, it raises an important question as to the ventilation. In going down into a sewer thirty feet in depth I found I could scarcely smell anything whatever. That is remarkable. With the open ventilation, if there was a pernicious gas let it come into the street and keep it out of the houses. I was surprised to find how free the sewer was from sewage gas. Perhaps Mr. Lobley could show how it was that the sewers were so clear of gas. As to the sludge, we saw how nicely it was taken from the tanks by gravitation. The sludge beds are temporary, and if the sludge is to be conveyed to the land, I should like to know how that is to be done? There is a remarkable honesty in dealing with the water from the sludge. In some places the polluted water from the sludge often finds its way into the water-course; but in this case it is pumped back into the tanks, the sludge remaining on the sludge beds. As to whether the sewerage was a separate or combined system, probably it was combined; but where we visited a manhole we found a convenient and ingenious

arrangement made whereby the whole of the sewage was taken in dry times, but in case of a heavy storm the water, by a leap-weir, was passed over. I think I might take it that they are storm overflows, not in the ordinary sense, but in the form of a leaping weir. I found that the depth of the sewers was fifty feet in some places. I should like to know what is the stratification of the ground? the size and description of the material of which the sewers are made? and whether any ill-effects have occurred? if pipes, have they been fractured; and if brick sewers, have they been distorted? In going great depths sometimes pipes are smashed and the pipemaker is the person who is blamed, whereas it might be perhaps that the engineer ought to have protected the pipes. I feel strongly that Shone's ejector is of great importance, and would be an advantage in raising small quantities of sewage from a lower to a higher level, and I should be glad to know if Mr. Lobley intended to make an experiment with it. We were told that the tanks were arranged on the understanding that there was to be frequent cleansing, which would add to the success of sewage purification in Hanley, but I did not understand how the cleansing was to be done, and in what state of consistency the sludge was to be removed. I can corroborate what Mr. Lobley said as to the small quantity of lime, although I am opposed to the use of lime where you can do without it. We were informed that in the water pumped from the mines, there was in solution a certain proportion of iron, and clay in that coming from the manufactories. These accounted for the small quantity of lime required to complete the precipitation. It would be instructive if Mr. Lobley could give the proportion of millions of gallons of water containing salts of iron.

Mr. LOBLEY, in replying to the discussion, said the drains on the principal filtration areas were 4-inch perforated pipes placed 6 yards apart; the gravel was as deep as the level of the river permitted the drains to be put in.

The approximate cost of the sewage outfall works was as follows:—First purchase by compulsory powers of 9 acres of land, 5590*l*. Second purchase by agreement of 14a. 1r. 7p. was 6750*l*. Laying out the filtration areas, including carriers, manholes, and sluice-valves for distributing the sewage, 1260*l*. The buildings for the engines, boilers, and machinery, 1300*l*. Pumping-engines, boilers, lime-mills, pulsometers, and all machinery, 1600*l*. The reservoirs and precipitating tanks, 3900*l*. Roads, fencing, and sundries, 600*l*. Total, 21,000*l*.

The daily amount of sewage resulting from the domestic water supply was 1,000,000 gallons, the amount of water pumped from the mines and discharged into the sewers varied much with the weather, and was greater in winter than in summer; the maximum quantity being 1,000,000 gallons per day. This water is discharged into sewers which were originally watercourses, and there is no alternative but to accept it or provide some miles of sewers to conduct it direct into the river where, under the Rivers Pollution Act, it may be discharged.

The quantity taken from the canal and afterwards finding its way into the sewers was very difficult to estimate; in many cases arising from percolation into defective drains on manufacturers' premises, in others taken for condensing purposes. No doubt where this can be proved to exist means will be taken to restrict it. The water containing clay may probably amount to 100,000 gallons per day on the average, it is very fluctuating, sometimes perceptibly whitening the whole of the sewage flow. The amount of sludge varies with the weather; rain washing the dust and mud off the macadamised roads into the sewers. That deposited in the reservoirs is found to be principally road detritus. That precipitated with lime would amount to about 10,000 gallons of slurry per day capable of flowing by gravitation on to the sludge beds. This, when dried enough to dig out with a spade, would be available for disposal to farmers. If they did not fetch it away it would have to be dug into the land and thus raise the level of the lower parts of the farm. As regards the cost of pumping: during the month of April, which was the only full month they had been at work, the quantity pumped was over 2,000,000 gallons per day, and the entire cost of coal was under 5%. It would be perfectly safe to put the cost of pumping at under 100% per annum; for it must be remembered if they did not pump the sewage into the tanks, steam would be required for pumping the sludge out of the tanks and mixing the lime, and probably have to work night as well as day. Hanley was not a water-closet town, there being not more than 600 water-closets. The separate system of drains for the rainfall was only carried out for some new districts and for long lengths of outlying roads; in all other parts the rainfall passes into the sewers. There is probably no non-water-closet town which has carried out entirely the separate system of drains for the rainfall.

The open system of ventilators acts very well, no complaints arising therefrom.

The crossings under the canals are by cast-iron pipes, of diameters varying from 9 inches to 18 inches, and in three instances by brick sewers.

The deep sewer executed in tunnel is in rocky ground, and is an egg-shaped sewer of 9-inch brickwork, with concrete filling up of all spaces outside, and timbers left in where found necessary. The shafts were sunk through beds of clay and marl into rocky ground below, coal being frequently met with. No instance of any distortion had been perceived. There was no doubt Shone's ejector would meet the requirements of the low-lying district, but it was a question of comparative cost between that and other methods.

Mr. Boys said the meeting had been very interesting in a sanitary point of view, and he could bear testimony to the excellent manner in which the works of Mr. Lobley had been carried out. He had not previously had the pleasure of seeing sewage works done in such a perfect manner; the ratepayers of Hanley ought to be congratulated on having a most complete and effective system of ventilation. In his town the sewers were not properly ventilated, the ventilating grids were few and far between, and consequently the sewage gas emitted at those grids became a nuisance in the immediate locality. The sewage works of Hanley were excellent, but there was much room for improvement in the method of road-making. The last time he visited Hanley, the streets were ankle deep in mud; to-day they were ankle deep in dust. This, however, was not the fault of Mr. Lobley, who, it seemed to him, ought to have a steam roller at his disposal to use in making and repairing the roads. He moved a vote of thanks to Mr. Lobley for his able paper and his explanations.

The CHAIRMAN, in seconding the motion, said the sewage works and the public baths would do credit to any town, but a good road in Hanley was a *rara avis*. He was surprised to hear there was no steam roller. He was sure that it must be to the interest of a large town like Hanley, with heavy traffic, to construct roads properly. He (the Chairman) could not help saying that he came to Hanley with some little prejudice in reference to the works he had seen, but he had no hesitation in saying that he should come again and see the further effect of them. He was sure they reflected the

greatest credit upon Mr. Lobley, and it must be a source of congratulation to Hanley to have a gentleman competent to carry out works in the manner that he had.

The resolution having been passed unanimously, Mr. Lobley said he believed the Corporation would have purchased a steam roller but for the heavy gradients in the borough. He was glad to hear that the steam roller worked easily on steeper roads than any there were with great traffic in Hanley. It so happened that the entire length of roads traversed by the Association that day were disturnpiked roads, only within three or four years come under the care of the Corporation, and since that they had been completely cut up with the sewerage works. Indeed, the road from Stoke to Hanley, along which the Members came, had within the last six months been sewered on one side, large water mains and gas mains removed to the other side, and the tramway laid in the centre. The road is still in the hands of the tramway contractor, and as the Corporation intend to pave some portions of the road, no attempt at a complete reinstatement had been made. Five years ago there were four distinct turnpike trusts, having nine miles of the main roads of the borough in their care. These trusts have now all expired. Hanley was unfortunately undermined, which caused continual breakages in gas and water pipes and drains, so that the roads were continually being broken up.

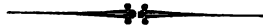
A vote of thanks was passed to the Mayor and Corporation for the use of the Council Chamber, and to Mr. Pritchard for presiding.

DISTRICT MEETING AT BARNSELEY,

May 28, 1881,

Held at the Queen's Hotel, Eldon Street, Barnsley,

Mr. A. W. MORANT, *President, in the Chair.*



ON the motion of Mr. Escott, seconded by Mr. Scott, it was resolved that Mr. B. C. Cross, of Dewsbury, should be re-elected Hon. Secretary for the Yorkshire District.

The following paper was then read and discussed:—

THE BARNSELEY SEWAGE WORKS.

By JOHN HENRY TAYLOR, Assoc. M.I.C.E., BOROUGH
SURVEYOR.

THERE are 300 water-closets and 3400 privies in the borough, of which privies 660 are on the common open midden principle, and 2740 are constructed on the covered dry ash system, from plans originating from, and designed by, Mr. Savage, our sanitary inspector; and many of the Members of our Association present to-day will, no doubt, find an inspection of this class of privy and ash-place useful and profitable.

The quantity of night-soil which is annually sold to neighbouring farmers is 3000 tons; and the quantity of ashes and refuse removed from ash-places and by our dust-carts is 6000 tons, which, unfortunately, we are at present obliged to deposit at selected neighbouring tips; but, through efforts made by our medical officer, Dr. Sadler, the question of providing one of Manlove, Allott, and Company's "Destructors" has now been brought to the fore, and we have reasonable grounds for believing that within a brief period from the present, the "tip" nuisance, so far as Barnsley is concerned, will be a thing of the past.

The average death-rate per annum for the last ten years is 25·61.

The streets and roads in the borough are twenty-four miles in length, of which only one mile is paved, the remainder being macadamised; and I am glad to be able to inform you that we have here in regular use one of Aveling and Porter's 15-ton steam road-rollers, which acts most satisfactorily.

The total area of the borough is 2385 acres, and the drainage area, which naturally falls into the valley of the Dearne and towards our sewage farm, is 1900 acres. The remainder of the area falls into the valley of the Dove.

The water supply of the borough, and of the several Local Board Districts adjacent hereto, is obtained from the Corporation reservoir at Ingbirchworth, about nine miles from here; the supply is on the gravitation principle and at the rate of twenty-five gallons per head per diem; this includes supply for trade, domestic, and public purposes.

The system of sewerage here is intended to be on the "separate system."

Within the last three years, seven miles of brick and earthenware-pipe sewers have been constructed water-tight, or intended to be, at a cost of 21,200*l.*, and contracts, amounting to 1440*l.*, have been entered into within the last few days for further sewers one mile long.

The sewers vary in size from 12 inches in diameter to 3 feet in diameter; the latter size being for the main outfall from Hoyle Mill to the screening tank at Burton Grange.

Provision for surface and subsoil water has, in many cases, been made by utilising existing culverts and drains which have been disconnected from the main sewers and made to discharge into the "dykes" or natural tributaries of the Dearne, and also by the construction of new surface drains; and here allow me to draw attention to the necessity of constructing all sewers, either of earthenware pipes or of bricks and concrete, perfectly water-tight where a sewage farm has to be managed economically and effectually.

The ordinary average dry weather flow on to the sewage farm is, in winter, 1,500,000 gallons, in summer, 1,000,000 per diem; the ordinary wet weather flow will average 2,250,000 gallons per diem.

One great reason for this serious difference between the ordinary

dry and the ordinary wet flow is that the old stone and brick main sewers, some of which were intended at the time they were laid to admit a certain quantity of subsoil and surface water for the purpose of cleansing such sewers, now, on the "separate system," require to be bodily reconstructed and made water-tight, and also that the whole of the fall pipes to buildings are connected to the main sewers. Another reason is one peculiar to mining districts, and that is the constant subsidence which is regularly taking place; thus breaking joints and in some cases crushing in the sewers.

The average rainfall per annum here, for the last ten years, is 28·65 inches.

The sewage farm is situate at Burton Grange, in the township of Monk Bretton, half a mile from the Stairfoot station on the M. S. & L. Railway, and two miles from the Barnsley Railway Station.

The soil of the farm is a red sandy loam for six-sevenths of its area, the remaining one-seventh being of a rather retentive clay, and would make fairly good bricks.

The total area acquired by the Corporation for sewage utilisation purposes is $78\frac{1}{2}$ acres; $58\frac{1}{2}$ acres being now fully drained and prepared, the remaining 20 acres being deep drained, but not otherwise prepared.

The farm is at present laid out as follows:—

| | |
|------------------------------------|------------|
| Rye Grass | 10½ acres. |
| Mangold | 14 " |
| Swedes | 2½ " |
| Parsnips, Beet, and Onions | 1½ " |
| Carrots | 2½ " |
| Cabbage | 8 " |
| Permanent Grass, &c. | 12 " |
| Osiers | 8 " |
| | <hr/> |
| | 58½ |

The total cost of the farm, including the purchase of the land and the laying out and stocking of the same, was 34,000*l.*; the great cost of the farm being attributable to the high price paid for the land.

As a means of clarifying the sewage of Barnsley, the success of the sewage farm is undoubted, and cannot be questioned.

In support of this statement, I cannot do better than quote the "Analysis of the Barnsley Effluent," by Professor Attfield.

"ANALYSIS OF BARNSELY EFFLUENT.

"By Professor ATTFIELD, Ph.D., F.R.S., F.R.C., F.C.S., Professor of Practical Chemistry to the Pharmaceutical Society of Great Britain, Author of a Manual on General, Medical, and Pharmaceutical Chemistry.

"LONDON, 17, BLOOMSBURY SQUARE, W.C.,
"January 12th, 1881.

"The analytical data (appended) show that the amounts of impurities in this effluent are not only much smaller than those admissible under official standards, but that the effluent actually approaches in character a not very impure drinking water. It may certainly be run into any ordinary river.

"(Signed) JOHN ATTFIELD.

"The first of the following two columns of figures shows parts per 100,000 parts, the second columns parts per 70,000 (grains per gallon) of the respective substances contained in the effluent :—

| | Parts in 100,000 parts. | Parts in 70,000 parts (or grains per gal.). |
|--|----------------------------|--|
| Total solid matter—dried at 212° F. | 44· | 31· |
| Nitrogen (as ammoniacal matter) | 0·017 | 0·012 |
| Nitrogen (as organic matter) | 0·012 | 0·008 |
| Nitrogen (as nitrates—no nitrites) | 0·83 | 0·58 |
| Chlorine (as Chlorides) | 4· | 2·8 |
| Temporary hardness (as chalk-grains or "degrees") .. | 6· | 4· |
| Permanent hardness | 17· | 4· |
| Total hardness | 23· | 12· |
| Lead or copper | none | none |

"The effluent is inodorous and fairly clear—almost bright.

"(Signed) JOHN ATTFIELD."

In conclusion, I have only to say that the new main sewers in the borough have been constructed under the supervision of my predecessor, Mr. J. H. Hanson, now of Huddersfield; that the main outfall sewer, screening tanks, and sewage farm have been designed by, and carried out under the supervision of, Mr. J. Bailey Denton, M. Inst. C.E., and that the sewage farm and other works in connection therewith have been practically laid out by, and are now under the management of, Mr. R. King, who has kindly offered to render the Members of our Association every assistance and information in his power.

DISCUSSION.

A discussion followed, during which Mr. Taylor observed that he had purposely not given a profit and loss account of the sewage farm, owing to the three or four preceding bad seasons, and, answering the President, that gentleman remarked that with reference to the subsidence of the ground, he had seen instances in which the land had gone down four or five feet.

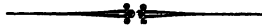
Mr. A. W. MORANT (President): I see you contemplate having a destructor. At Leeds it is found that destructors answer their purpose admirably, and by means of them the Corporation have effected a saving of 2000*l.* per year each.

Replying to further questions, Mr. Taylor observed that there had been an injunction hanging over the town for something like ten years, and that the death-rate had been lower since the sewage farm had been formed.

The Members afterwards visited the Sewage Farm, and discussed the various matters connected with the Corporation.

ANNUAL MEETING AT BIRMINGHAM,

July 7, 8, and 9, 1881.



ADDRESS OF THE PRESIDENT,

W. S. TILL, M.I.C.E., BOROUGH ENGINEER, BIRMINGHAM.

GENTLEMEN,—In taking the Presidential Chair, allow me to thank you very sincerely for the honour you have conferred upon me, to express the hope that during this the third visit of the Association to this borough some useful information may be gained by the Members, and that the objects of the Association, viz. the dissemination amongst the Members of that knowledge and practice which falls within the department of an engineer or surveyor engaged in the discharge of his duties under the Local and Public Acts of Parliament, may be attained. It has, therefore, occurred to me that a brief description of the borough, together with information as to its streets, night-soil, and sewage works, would be the most interesting subjects for me to address you upon.

The borough of Birmingham has an area of 8420 acres; its lowest point, which is at Saltley, where the sewage works are situated, is 290 feet, and its highest, which is on the Hagley Road, is 610 feet above mean sea-level.

The population in 1861 was 296,076; ditto 1871, 342,505; and ditto 1881, 402,296; whilst the rateable value at the present time is 1,528,000*l*.

The area unbuilt on is about 2400 acres, so that the population per acre is 66.

It is surrounded by the populous districts of Smethwick, Aston, Handsworth, Saltley, Balsall Heath, and Harborne, with an additional population of about 150,000 persons.

Highways.

In the borough there are 187 miles of highways repairable by the Council, and, with the exception of some 15 miles, which are paved with wood and granite, the whole of the carriageways are macadamised. There are in addition about 10 miles in length of private roads.

The average cost per square yard per annum of cleansing, watering, and macadamising the carriageways, for 1880, was 5*d.*; the maximum cost of any one street for that year was 4*s.* 3*3*5*d.*, whilst the first cost of making is about 2*s.* 3*d.* per square yard.

The first cost of a granite paved road (3-inch by 6-inch stone on 6 inches of concrete) is 14*s.*, and the first cost of a 3-inch by 6-inch wood-paved road is now 15*s.* per square yard.

Wood pavement was first laid by the Improved Wood Pavement Company, in Moor Street, in 1873, and this consisted of 3-inch by 6-inch blocks on two layers of boards; it was found necessary to take up and relay this pavement in 1879, when 6 inches of concrete were substituted for the boards.

There are about 30,000 square yards of wood pavement in the borough; that in Bull Street was laid in 1874, and has not yet been interfered with, but now requires relaying. The company were paid 14*s.* per yard for this as well as several other lengths; they maintain the same free of charge for one year, and for fifteen years thereafter for the sum of 9*d.* per square yard per annum, the maintenance money being payable at the expiration of the sixth, eleventh, and sixteenth years, on the surveyor's certificates that the works are in good condition. Wood pavement was laid in connection with the tramways in front of the Town Hall in 1875, pitch-pine blocks being used adjacent to the metals; this pavement was taken up and relaid in 1879, and it should be stated that the tramways at this point are only used to a very limited extent.

The first lengths of granite pavement now in existence were laid in Broad Street and Lawley Street in 1862; the money for such works is now obtained under the sanction of the Local Government Board, who have authorised the repayment of moneys borrowed for wood pavement being spread over sixteen years, and for granite for twenty-five years.

I find that taking streets of heavy and concentrated traffic, like

Bull Street and High Street, the respective costs are as under, viz.:—

| Material. | First Cost per Square Yard. | Average Annual Maintenance, including First Cost and Repayment in Sixteen Years. | Cleansing. | Watering. |
|-----------|-----------------------------------|--|---------------------|-----------|
| | <i>s.</i> <i>d.</i> | <i>s.</i> <i>d.</i> per sq. yd. | <i>s.</i> <i>d.</i> | |
| Macadam | 3 0 | 3 0 | 1 3 | ·35 |
| Wood | 15 0 | 1 11½ | 0 5 | ·25 |
| Granite | 14 0 | 1 4 | 0 5 | ·25 |

For footways, various descriptions of paving materials have been adopted ; in the better streets, 2½-inch York flagging has been largely used, costing about 7*s.* 5*d.* per yard complete. Caithness flagging was first laid in New Street in 1860, and costs 7*s.* 11*d.* per square yard ; whilst, more recently, the mastic asphalt, ½ inch in thickness on 3 inches of concrete, has been laid in several streets, the charge for same being 5*s.* per square yard ; the companies contract to maintain this description of pavement for five years free of charge, and for ten years thereafter for 1*d.* per yard per annum.

In the second- and third-class streets, blue vitrified brick pavements are used, the bricks being 10 inches by 5 inches, by 2½ inches deep, and their cost 2*s.* 3*d.* per square yard ; the repayment of moneys expended for this description of pavement is spread over twenty-five years.

The suburban streets which have not gravelled footpaths are paved with 2½-inch tar or limestone pavements, the first cost of same is 1*s.* 5*d.* per square yard ; they are maintained for two years free of charge, and for ten years thereafter for 1*d.* per yard per annum ; the repayment of moneys expended for same is spread over ten years.

Night-soil.

The Council, in 1872, with the view of reducing the difficulties connected with the treatment of the sewage at Saltley, decided upon the introduction of the pail system for collecting night-soil, and at the end of last year there were about 32,000 pails in the borough, estimated to supply about 250,000 persons ; there are about 10,000 water-closets, and the remainder of the population is supplied with the old form of combined privy and ash-pit. The

contents of the pails, and ash-tubs used in connection therewith, are collected weekly, and conveyed to wharfs within the borough, situated at Rotton Park Street, Shadwell Street, and Montague Street; the latter it is proposed to visit, when the Chairman of the Sub-Committee and the Superintendent of the Department have kindly promised to attend and give full explanations.

The contents of the old privies are removed as often as required, and sold, after being roughly sorted; whilst the contents of ash-tubs are screened, mixed with the fecal matter, and sold as manure.

At Shadwell Street Wharf, some four or five years ago, the Council erected one each of Fryer's four-celled Destructors and Carboniser, and also two of his Concretors; the two former performed their work in a satisfactory manner, the destructor reducing six boat-loads of rubbish, or about 150 tons, to 25 tons, and the carboniser turning out a very fair charcoal, but owing to continual complaints by the General Hospital authorities, whose hospital is only separated from the wharf by the canal, the use of the whole of these had to be abandoned, and the mixing of screened ashes and excreta is now only carried on there.

At Montague Street Wharf, within the last three years, the Corporation have erected an engine-house, wherein are two 25 horse-power engines, stack 260 feet high of 12 feet internal diameter, with two-story buildings, stabling, three multitubular and two Galloway boilers, the latter being each 27 feet 6 inches by 7 feet 6 inches, averaging 60 horse-power each; three of Firman's dryers, manufactured by Manlove, Alliott, and Company, of Nottingham, and two supplied by Messrs. Forrest, of Manchester.

The dryers each consist of a steam-cased cylinder, into which steam produced by the boilers is passed; after condensation has taken place, the heated water is returned into the boiler. In the inner cylinder is a shaft with hollow revolving arms, through which steam is driven, and the contents of the pails are kept continually in motion until sufficient dryness is attained.

The quantity of pails delivered to this wharf amounts to about 17,000 per week, the contents thereof are estimated to weigh 466 tons, whilst the average quantity of ashes collected weekly from the premises where these pails are in use averages 506 tons.

The pail contents treated by the dryers are passed into tanks where the paper, &c., are removed therefrom, 30 lbs. per ton of sulphuric acid being added thereto for the purpose of fixing the ammonia. The dryers are charged from these tanks, and it has

been found that one ton is the most suitable quantity for the Firman, and two tons for a Forrest machine.

It has been ascertained that a Firman machine takes, on an average of several experiments, fourteen and a quarter hours to reduce the contents to a sufficiently dry state, and that the average product of poudrette amounts to 2 cwt. 3 qrs. 2 lbs. or a reduction of about $\frac{1}{12}$ ths; whilst a Forrest machine takes nine and seven-eighth hours, on an average, to reduce two tons of excreta to a like dry state; the yield of poudrette therefrom averages 2 cwt. 3 qrs. 12 lbs. The Firman machines are charged about eight times, and Forrest's about twelve, per week; the total quantity of excreta treated weekly by the five machines, when all are at work, has averaged 72 tons, the product being $6\frac{1}{2}$ tons.

The vapour from these machines is drawn off by one of Root's blowers, it is thence passed through the condenser, the liquor being discharged into the main drain without nuisance.

The steam used for the engines and dryers is largely generated by means of the collected refuse.

Numerous experiments have been tried with the dryers, and it has been found that by the addition of slack to the refuse used under the boilers much more satisfactory results have been obtained.

The cost of the Night-soil Department in 1880 was 42,996*l.* 17*s.* 5*d.*, of which 27,196*l.* 2*s.* 2*d.* was for collection, &c., of pail contents, and the remainder for the removal of old night-soil; the receipts for pail contents were 5702*l.* 3*s.* 1*d.*, and for old night-soil 1992*l.* 8*s.* 7*d.*, or a total net cost to the borough of 35,296*l.* 5*s.* 9*d.*

The superintendent of this department states the number of pans in use in the borough on the 31st of December last was 31,925, and that the carrying out of the work of his department involved the collection during the year of 1,621,360 pans and 69,256 loads of ashes, whilst under the old system 21,715 privies and ash-pits were emptied, and 71,402 loads of ashes, &c., removed therefrom.

The systematic drainage of the borough of Birmingham was commenced in 1852 by the construction of the Hockley Brook and River Rea Main Intercepting Sewers under the superintendence of Mr. Pigott Smith, the then Borough Surveyor. These sewers are egg-shaped, 5 feet 9 inches high by 3 feet 6 inches wide in their lower portions, and they drain an area of 7287 acres out of 8420 acres comprising the borough. An area of 87 acres has its

sewage lifted by pumping at the outlet works, and the drainage and treatment of the sewage of about 956 acres lying in the valley of the River Cole is now under consideration. The subsidiary drains in the borough consist of 12 and 15-inch stoneware pipes, and of egg-shaped brick sewers, varying in size from 1 foot 9 inches by 1 foot 3 inches to 3 feet 6 inches by 2 feet 6 inches. The house connections are generally 6-inch stoneware pipes for dwellings of an ordinary description. The sewers are ventilated by open gratings, placed about 100 yards apart; in some instances side catch-pits being used to prevent dirt and stones falling into the sewers of the smaller sizes. Owing to the natural situation and configuration of the town the gradients of the sewers are almost universally very good. The total length of sewers under the care of the Council is about 175½ miles. The average annual rainfall for the ten years ending 1879 was 33·66 inches, of which on thirty-five days per annum the fall was one inch and upwards, the wettest day being June 30th, 1873, when 2·8 inches of rain fell in the twenty-four hours.

Sewers and Sewage.

The history of the treatment and disposal of the sewage has, until recently, been one of difficulty and opposition. In 1855, the Borough Surveyor, Mr. Pigott Smith, presented a report, strongly recommending irrigation; and in 1858, Sir C. B. Adderley (now Lord Norton) obtained an injunction to restrain the Corporation from discharging sewage into the Tame. Two large tanks were constructed in 1859, and clarification by means of deposition and upward and downward filtration was tried, but filtration was abandoned. Various small areas of land were obtained at Saltley from time to time, for facilitating the disposal of the sludge from the tanks, and for irrigation with the effluent, but the progress not being rapid enough, Sir C. B. Adderley, in 1870, again applied to the Court of Chancery, and an order of sequestration was obtained. About the same time, another injunction was obtained by other owners of property, for the purpose of preventing the accumulation of sewage mud near the subsidence tanks. In consequence of these proceedings, the Public Works Committee, which then had the matter in hand, presented a report to the Council in June 1871, recommending the acquisition of from 2000 to 2500 acres of land down the Tame Valley, but this being considered too costly,

the Corporation, on the recommendation of the Sewerage Committee, which was specially appointed for the purpose, promoted a Bill in Parliament, in 1872, for the purchase of 800 acres of the same land near Kingsbury, about eight miles below the present outlet. This Bill, after a lengthened opposition in Committee, was thrown out on the third reading in the Commons, owing to the opposition of the landowners in the neighbourhood. To satisfy the requirements of the Court of Chancery, the lime process was at once adopted, on the advice of Mr. Hawkesley, for which purpose more land was obtained at Saltley, and four additional sets of subsidiary tanks were constructed, to which another large tank has recently been added. The order of sequestration was discharged in 1875, and in 1877 the United Drainage Board (to which allusion will presently be made) was formed. On this Board now devolves the duty of treating and purifying the sewage delivered by the various constituent authorities at the outlet works. To meet the additional strain thus brought on the works, the Board last year entered into negotiations for the acquisition of 867 acres of land in the neighbourhood of Castle Bromwich, to be used for irrigation with the effluent from the tanks. The Board was met in a friendly spirit by the landowners, and terms satisfactorily arranged; and considering the large area of land thus acquired, its very favourable nature and situation, and the difficulties that formerly attended the Corporation in negotiations of a similar kind, the Board has every reason to feel satisfied with its arrangements. The Local Government inquiry was held in April of this year, for power to borrow 188,000*l.* for purchase of land and works, and the requisite permission has been recently granted.

The area of the present Saltley Farm is 272 acres, of which 170 acres are freehold. The subsoil is generally of a gravelly nature, with a little clay in places. The three large tanks and sixteen smaller ones have a combined capacity of 43,310 cube yards, or about 7,300,000 gallons. The amount of sludge deposited in the tanks, during 1880, was 178,400 cube yards, or about 490 cube yards per day, and required an area of 53½ acres of land for digging in the same, or rather more than 1 acre per week. The average dry weather flow of sewage is about 13,000,000 gallons per day, the population actually contributing this amount being estimated roughly at 450,000, being about 29 gallons per head. A little over thirteen tons of lime are used per day, the lime being slaked and ground with water under edge runners.

The sludge is lifted from the tanks, run into beds about 8 yards square to a depth of about 18 inches, and allowed to drain for a week or two; it is then dug into the land, and covered with the soil. The thorough drainage of the land greatly facilitates the operation of dealing with the sludge. The sludged land is very favourable to the growth of cabbage, kohl rabi, and mangold, as much as sixty-three tons of the latter being obtained per acre. No nuisance arises from the present method of dealing with the sludge, as is sufficiently proved by the fact that there are nearly 3000 houses within half a mile of the farm boundary, no complaints being made by the inhabitants thereof as to the operations now carried on. The cost of dealing with the sludge during 1880 (i. e. lime, labour, repairs, rent, taxes, &c., but exclusive of interest and sinking fund on capital) was 12,356*l.*, or about 1*s.* 4½*d.* per cube yard of sludge intercepted. Owing to the sharp gradients of the sewers and the nature of the roads (being generally macadam), a large amount of detritus is carried down to the tanks.

The new farm is not yet laid out, but it is intended to connect it with the Saltley farm by a conduit about two and three-quarter miles long and 8 feet internal diameter. The land is of a very favourable nature and contour, the subsoil being nearly all sand and gravel, and of such a level that 800 acres, or nearly the whole, may be brought under irrigation by gravitation. It is proposed to lay it out for broad irrigation, except about 40 acres intended as an intermittent filter bed for use in cases of emergency. About 648 acres will be freehold, and the remainder leased for long periods. It is favourably situated for disposal of produce, being within an easy distance of Birmingham, with which it is well connected by road, canal, and rail. Owing to the acids contained in the sewage from the numerous galvanising and other works, the liming will still be continued after the new farm is in work, but probably to a less extent, and a considerable amount of sludge now intercepted in some of the tanks be carried on to the land with the effluent.

In consequence of the increasing difficulties encountered by the borough and some of the surrounding districts in intercepting and dealing with their sewage, it was resolved to combine under the provisions of the Public Health Act 1875, and in 1877 the Birmingham, Tame, and Rea United District Drainage Board was formed, and confirmed by Parliament in the following session. The district comprised an area of 34,245 acres, to which the parish

of Sutton Coldfield, containing about 13,000 acres, has recently been added. The total population is estimated at about 550,000, and the ratable value about 2,100,000*l*. The objects to be obtained by the union were, increased facilities for intercepting the sewage of the various districts; and the disposal of the same at outfall works. By the former provision running powers to the extent of 40 gallons per head are obtained by various districts through the existing main sewers of other districts lower down; these powers have been extensively used by several of the constituent authorities; and it is not too much to say that without this privilege the work of obtaining suitable land and conveying the sewage thereto would be, financially speaking, impossible to several of the authorities comprising the Board. The working of the Board has been very satisfactory.

Since the visit of the Association to this borough in 1874, the Corporation have expended very large sums of money in the acquisition of the gas and water undertakings, in sewerage, paving, and other works of a similar character, as well as about 1,500,000*l*. under the powers of the Artizans' Dwellings Act, such works being undertaken with the view of adding to the health and comfort of the inhabitants, and it is satisfactory to find that whilst the death-rate per 1000 of the population from 1870 to 1876 averaged 25·2, that from 1876 to 1881 averaged only 22·7, the rate for last year being 20·5.

In conclusion, I have to apologise for having taken up so much of the limited time at your disposal, and to say that I shall gladly do all in my power to assist the objects of the Association.

ANNUAL MEETING AT BIRMINGHAM,

July 7, 8, and 9, 1881.



BIRMINGHAM SEWAGE WORKS.

DISCUSSION.

THE PRESIDENT announced that discussion would first be taken on the Birmingham Sewage Works, visited by the Association on Thursday.

Mr. LEMON: I beg to acknowledge the kindness and courtesy shown to the Association by Alderman Avery, Mr. Councillor Martineau, and other members of the Birmingham Sewage Committee. So far as the sewage works at Saltley are concerned, I have very little criticism to offer. On the whole, they reflect considerable credit upon the President, for the manner in which they have been designed and carried out, and are an evidence of the public spirit shown by the Corporation of Birmingham. A few years ago I made some strong observations upon the opposition offered by the then landowners in the neighbourhood, when the Bill for acquiring land for irrigation promoted by the Corporation was thrown out of the House of Commons by the votes of three members. The remarks I then made provoked a great deal of discussion—in fact one gentleman told me that I ought to have an action brought against me for libel. That the Corporation were on the wrong track by adopting precipitation is pretty evident from the steps they have taken. They have found out the difficulty of dealing with the sludge of a large town like Birmingham; the President's statistics showing that an acre of land per week was required. I think the Corporation has acted wisely in taking powers to acquire more land, so as to reduce this difficulty to a minimum; and doubtless they will ultimately endeavour to dispose of the sewage as much as possible upon the land. The inter-

cepting works, however, are not so satisfactory. Mr. Martineau invites criticism and suggestions from Members of the Association respecting these works. Any criticism I offer will be made in a friendly spirit, and if I say anything which might appear severe, I hope I shall be forgiven by the members of the Sewage Committee. At the same time I must offer a strong protest against what I consider one of the most disgraceful exhibitions of sanitary work I have ever seen. It was my privilege to see the works at Manchester, where a similar system was practised opposite the abattoirs, and the dust was blown from the works upon the meat; and according to the views of some persons nothing could be more admirable than this. I am informed the Manchester Corporation have seen their folly, and have now removed their works elsewhere. I hope the Birmingham Corporation will also speedily see their folly, and that the day is not far distant when they will altogether abandon the Montague Street abomination. I do not see why there should in any town be two sewage systems, one for the rich and the other for the poor. This, however, appears to be the principle; that the rich man should have the water-closet, the poor man the pail. I protest against the pail system as both unsanitary and expensive. We are told that in Birmingham the cost is 35,000*l.* a year, which, if capitalised, represents something like 1,000,000 sterling. If Mr. Till had 1,000,000 sterling to work with, I am confident he could produce something better than the pail system. There are about 300,000 of the population using the pail system, and the remaining 100,000 use water-closets. There is drainage for the 300,000 who have the pail system, and therefore I do not see why the excreta should not also be removed by water carriage. I know from my own experience and professional knowledge that it requires very little more land to dispose of the whole of the excreta than is needed for the slops only. Therefore it is absurd to talk about increased expense. It is alleged that they get rid of the difficulty of the sewage at the outfall, but it costs 35,000*l.* a year to do it. I am ready to admit that part of this heavy expenditure is for the removal of ashes, but I maintain the existing system of sewers in Birmingham is quite capable of removing all the excreta from the borough by the water-carriage system, more efficiently, and with far less nuisance, than by the system carried on at Montague Street and elsewhere. The cost to owners of substituting ordinary pan-closets, either Mr. Fowler's or any others, for the present pails

would be very little. Every engineer knows that the cartage of liquid, *per se*, is about the most expensive system that could be adopted. Clearly liquid could be conveyed by gravitation at a very much less cost than by cartage. The mere expense of removing the pails is a great increase of cost. But, apart from this, I regard the whole system as a great abomination. It is a very unsanitary system, is very likely to spread disease, and has about it what is revolting to every sanitarian. The sorting of the paper, the picking out the rags, and then sending them away to spread small-pox or other infectious diseases in all directions, are a great abomination; simply sending away those things is open to very serious objection. I am therefore utterly at a loss to understand why the Birmingham Corporation continues to carry on such an abominable system. It cannot be on the score of economy, because it could be demonstrated that the other system would be the cheaper. If it were urged that they have gone on with the pail system for so long a time that they did not see how to retrace their steps, the authorities could at least require water-closets to be provided in the new buildings, and encourage owners to substitute them for pails in existing houses. I suppose the cost of making the necessary alterations and connections would not exceed 5*l.* per house. No doubt such a compulsory charge would provoke some opposition from owners of property, but in a sanitary point of view the advantage to be derived from such a change cannot be over-estimated. The Members of the Association, therefore, would not be doing their duty as sanitarians if they did not openly and fearlessly condemn one of the most abominable systems of this country.

Mr. MORANT: I am satisfied there would be no greater difficulty in dealing with the excreta at the outfall works, and the additional cost would be very slight.

Mr. GLEDHILL: I represent Heckmondwike, a small town in Yorkshire. One of Fryer's Patent Destructors was put into operation about two years ago, and works satisfactorily. We were told by Dr. Thorne, one of the medical officers of the Local Government Board, that the whole of the refuse from the town should be either disinfected or destroyed. I came to Birmingham expecting to learn something, but I find a number of brick ends and other rubbish from the town refuse being put into a boat, and I am told they are then sent away to tips in the country. I should like to ask the President if that is a fact?

The PRESIDENT: It is so.

Mr. GLEDHILL: I am very sorry to hear it; I should not recommend my Board to adopt the Birmingham plan of sending portions of the refuse from the depôt until it had passed through the destructor or been thoroughly disinfected.

Mr. ELLICE-CLARK: After the onslaught that has been made upon the intercepting system, which we inspected yesterday, I should like to have heard something in defence of the pail system from the Engineers and Surveyors of other towns where it is in operation. It is no unusual thing for the Members of this Association to come from the south of England and condemn this dry intercepting system. On each occasion that the Association has visited a large town, to use the words of Mr. Lemon, we have entered our protest against the continuance of the pail system. When we went to Manchester, we saw something which justified the use of the term "abomination." The Birmingham Corporation have cleared away from the eye much that was offensive at Manchester; and at the latter place the intercepting works have been removed out of the town. This, however, does not affect the principle of removing the solid matters. It may seem curious, but it is a fact, that at Birmingham, a town with 400,000 inhabitants, we have the advantage of seeing two systems of dealing with the sewage in operation. I do not think there is any other town where we should find the details of the two systems carried out to such perfection, or where so large an amount of money has been spent, or so much energy exhibited. The pail system has attained its greatest possible advantages at Birmingham. The excreta, however, could be removed much cheaper by water carriage than by any mechanical means. We were told by eminent chemists, and could prove it by certain tests, that after the large quantities of excreta we saw being treated at Montague Street had been taken out of the sewage, there still remained in it almost as large an amount of offensive matter as if none of the excreta were taken out. The volume of the sewage remained practically the same. The carriage would not be increased at all if the whole of the sewage were removed by water. It would seem as if they paid 35,000*l.* per annum for the removal of the ashes; that is nearly 2*s.* per head, a very large figure indeed. We have been told over and over again that a certain amount of the population in Birmingham were not suited to the water-closet system; we have heard on all hands that if they introduced water-

closets into Lancashire and Yorkshire, as they have done in the south of England, the system would be an absolute failure. This has been practically answered by actual experience in Liverpool and Leeds, two typical towns in the north of England. In Liverpool there is a large migratory population which has no interest in the houses they occupy or the places where they live. This is the most difficult population to deal with sanitarily, and yet in Liverpool, where it was introduced in 1848 by Mr. Newlands, the water-carriage system is carried out in its integrity. It may be said that the death-rate has not shown any marked decrease since doing away with privies. But it must not be forgotten that at Liverpool there were about 300,000 Irish landed in 1848, and more than 50,000 permanently took up their abode in the borough; besides which, there are other reasons why the death-rate there should be abnormally high. Still it is shown that since the water-carriage system has been perfected, and the ventilation of the sewers carried out, the death-rate of Liverpool has steadily declined. Leeds has a population somewhat similar to Birmingham; the water-carriage system has also been partially carried out there. If the water-closet system could be successfully carried out in Liverpool and Leeds, it was clear and decisive proof that closets could also be safely introduced into Birmingham and other towns. It is really difficult to understand why the dry intercepting system was continued. It can hardly be regarded as the pet hobby of a strong-minded individual, for Birmingham and many manufacturing towns appear to be so thoroughly in earnest, and convinced that they are carrying out the right system. Still we never get any facts or statistics relating to it; we never find any one bold enough to come forward with a paper and compare the two systems, one by the side of the other, and demonstrate that the pail system is the better. This is certainly extraordinary when we bear in mind that the pail system is year by year extending over the north of England. Why do not its advocates get some facts and statistics and prove the superiority of the pail over the water-closet system? When we next visit the north of England, I hope that a special feature will be made of this subject, even if we go to the expense of obtaining the necessary statistics for a paper, so that the whole matter may be thoroughly threshed out.

Mr. J. LOBLEY: Mr. Clark wishes to have the opinions of members from other towns which have decried the water-closet

system and have adopted the pail system. Up to ten years ago I had experience with the water-closet system in Liverpool, where it has probably been carried out the best of any city in the world. When I left Liverpool, I went to a town which decried the water-closet system with the greatest vigour. Although they had very very few closets, they looked upon the system as the source of all their injunctions, and therefore regarded it with the greatest horror. For ten years I have tried to reconcile myself to the horse-and-cart system, and so far have failed. I cannot see any benefit in it whatever. When the Birmingham works were described yesterday as approaching perfection, and that this was the system of the future for dealing with the night-soil of the great bulk of the populations, I could not suppress the thought, "God forbid that this should be the acme of civilisation." No doubt great objections have been raised to the water-closet system, but they are attributable to want of knowledge and skill in carrying it out, in a great measure owing to miserable defects in the plumbing arrangements allowing sewer gas to gain admission into houses. In order effectually to carry out the water-closet system, it is not at all necessary that the closets should be fixed inside the dwellings of the humbler classes. If a rich man desired to have a water-closet in his villa, it could be so disconnected from the sewers that no sewer gases could possibly enter the house. Another objection raised was the amount of water which a water-closet required. This has been exploded and refuted over and over again. At Liverpool, where the water-closet system is in force, the average consumption per head is 13 gallons per day; but I am told by Mr. Gray that the daily consumption approaches 30 gallons per head in Birmingham, which is not a water-closet town. No doubt there is a good deal of waste; but it is not due to water-closets. If a tap were used without any separate cistern, it is of very little use for closets; what is wanted is a sudden flush of water. We certainly find the pail system carried to great perfection in Birmingham. The pails are removed in the night; though, with air-tight vessels, I cannot see why it should not be done during daylight. The pail system has been in operation in Hanley for about eight years, and although it is certainly a great improvement upon the old middens, I hope it will not last for ever. I believe there is a growing conviction that the money expended on collecting the night-soil is absolutely being thrown away. Although at Hanley pails are only used for new buildings, the cost to the

borough is over 1000*l.* a year, but if the whole sewage went into the sewers, I do not think the cost of dealing with it would be increased 100*l.* a year, and I very much doubt whether there would be any actual increase at all. I have observed the sludge from water-closet and non-water-closet towns, and cannot find any difference between the two. The Hanley sludge contains a great deal of detritus from the macadamised roads, which is rendered offensive by urine and slops. It is thus rendered quite as offensive as the sludge from any water-closet town. Mr. Clark has referred to Leeds as a water-closet town, but I do not think Mr. Morant would admit that it was a fair example of one.

Mr. MORANT: I was about to contradict that statement by Mr. Clark.

Mr. LOBLEY: Every town adopts the water-closet system more or less, and in Manchester every house over 50*l.* a year has its water-closet. There is always difficulty in dealing with the sludge, which is much more valuable and likely to be taken by farmers if it contained the whole of the excreta, though in either case the value is certainly very slight. When Liverpool was cited as an example for Manchester to follow, the latter turned round and said, "at Liverpool you can pour the effluent water into the sea." This was an argument which will be used in Birmingham, and I know that it has some influence at Hanley. I, however, think the opponents of the water-closet system have still to prove their case.

Mr. MORANT: In Leeds all houses above 30*l.* a year have water-closets, but at the same time there are privies for servants. The Corporation are endeavouring to introduce trough privies where alterations are made; but Leeds cannot be said to be a water-closet town.

The PRESIDENT: You have but few trough closets.

Mr. MORANT: We have a good many now.

The PRESIDENT: I am speaking of two or three years ago.

Mr. McKIE: Carlisle was the first town in England to adopt Sewage Irrigation. It is entirely a water-closet city, and the death-rate has been much reduced since the sewerage system was carried out. With respect to the Birmingham Irrigation Farm and Subsidiary Tank System, I can only say that it was far better to see it than merely to read a description of it. When I had heard the system spoken of, I was led to believe that it was quite impossible to live within two miles of the place, owing to the terrible stench. When I saw the process I was obliged to modify

my views, as there was no offensive smell, nor were there any complaints of a nuisance arising from the farm from any of the occupants of nearly 3000 houses which are within half a mile of the boundary of the farm. From the first I have been in favour of irrigation. The land is the natural purifier of sewage, and I would apply it direct, before there could be any decomposition of the sewage, in settling tanks, or anywhere else. This I did at Carlisle. A great deal has been said for and against the Edinburgh Irrigation, but I would advise every one to go and see it for himself. Doctors and chemists who have given the matter thorough consideration, and who have done everything they could to find defects, now generally admit that irrigation is the best mode of dealing with the sewage. The pail system was an improvement on the old common type of privy. If a toy windmill were fixed over the seat-hole of the old privy, it would almost continuously be rapidly turned round by the enormous rush of offensive gas up into the privy through the seat-hole. The Americans are a great deal in advance of us in the construction of their privies. They are far better than the English ones. Instead of an offensive draught continuously rushing up from the seat-hole, the American privies are ventilated down the seat-hole and by an up-cast shaft or flue; and their privies are consequently better ventilated and comparatively free from objection. Whether the pail system would be superior to properly constructed privies I am not quite prepared to say. I must fall back, however, upon the system I have always advocated, namely to get the whole of the sewage away as far from the town as we can, and in as short a time as possible, and then deodorise it in some way, and make it permanently innocuous. In my opinion the best way to do this is by irrigation.

Mr. JONES: I would suggest that the time is approaching when this discussion should be brought to a close. I should have liked to have heard some one stand up and advocate "tooth and nail" the pail system which we inspected yesterday. It was most repulsive to find that in some little place outside the back-door of cottages there was a large pail, into which all the excreta of the family were received. It was repugnant to the intuitive decency of even the feline race, which instantly covered over whatever it evacuated, and a cat would certainly chastise her kitten if it failed to observe this act of propriety. There may have been some good reasons why the pail system should have been adopted years ago, but I shall never forget what we witnessed in connection with

it when the Association visited Manchester. The reminiscences of it have remained with me to the present date. The pond we saw at Manchester was something indescribable, and I am very glad to learn that this abomination has now been removed. Birmingham has certainly got a step forward, and the managers are doing their best to get rid of the difficulties connected with the system which they apparently believe in so firmly. I should not have been so surprised if the advocates of the system were ignorant upon the subject. A man with a crotchet will swear black is white, and it is simply impossible to convince him that he is wrong. At Birmingham, however, we find gentlemen of influence and of scientific knowledge advocating the system, and it staggers me to find that we should differ so completely upon a question of such importance. Cleanliness is said to be next to Godliness. I regard cleanliness as before Godliness, though I should not like to press this so far as to argue that Birmingham and Manchester must therefore necessarily be Godless towns. I regard the Birmingham pail system, though carried out in the best possible way, as nevertheless crude, rude, and altogether bad.

Mr. JENNINGS: Before this Association was formed, I always advocated and supported the water-closet system. Though it often met with great opposition from cottage owners, I have no hesitation in saying that the water-closet system is the best and the cheapest, wherever properly carried out and properly managed, especially for towns where the population exceeds 20,000.

Mr. LEWIS ANGELL: I have been very much disappointed with the discussion, because it has been so thoroughly one-sided. Speaker after speaker has denounced the Birmingham pail system, and I had hoped some one from the north would have defended it. I entirely approve of the water-closet system. What the Association has seen in the north would not be tolerated for a moment in the south. I certainly regard the pail system as dirty, filthy, degrading, and demoralising. It is opposed to all decency; it necessitates a disgusting occupation for a number of people, and as we saw it carried out yesterday, it is a most admirable system for disseminating disease in all directions. Rags and other things are sorted out of the filth collected in the town, and are then sold for a small profit, and sent all over the country. I know that at Maidstone, where rags are brought from all parts to paper mills, the infection thus imported has given rise to a considerable outbreak of small-pox. If these things were all collected,

as at Birmingham, the best plan would be to destroy them all at once. Besides, I cannot see the object of having such a system. Mr. Lemon and Mr. Clark have shown that there must also be the water-carriage system, and we have before us plans of the Birmingham extended scheme, with a large culvert, 8 feet in diameter, for carrying the sewage away. This would take all the sewage to Saltley, where an immense amount of money is being expended; and if this were done, they would get rid of a filthy nuisance at Montague Street. There is no more difficulty in getting rid of sewage at the outfall than there is with dealing with the contents of pails at a dépôt in the town. If the pail system were adopted at all, I should much prefer the French method of pumping the contents into air-tight vessels, so that nothing was ever actually seen. We do not wish to appear ungenerous, but we are invited to criticise the Birmingham works. There were many things to admire in the works as works, but the system was wrong. Some things which have been said have been rather caustic and pungent; but I hold we should have been wanting in our duty as engineers if we had not honestly expressed the views we entertained respecting the system. My firm conviction is that, in the end, the water-carriage system will prevail.

Mr. E. PRITCHARD: The system of interception has been so vigorously attacked, and the discussion has been so completely one-sided, that I will content myself with saying that I do not approve of the system of interception and pan removal. As Honorary Secretary of a district, I think it my duty to give the Association the opinions of Mr. Rawlinson, Chief Inspector of the Local Government Board, with reference to the pan system for the removal of excreta. Mr. Rawlinson is an Honorary Member of this Association, and I sent to him the customary invitation to attend this meeting, and intimated it was our intention to visit the Birmingham Intercepting Works, which were admirably constructed, the most complete of their kind, and reduced the nuisance therefrom to the minimum. Mr. Rawlinson referred me for his views as to the intercepting system, to the Report of the Royal Commissioners, 1880, upon an inquiry into the sewerage and drainage of the city of Dublin. After hearing the advocates, and there were many of them in Dublin, that the pan-removal system should be there adopted, and after denouncing in strong terms the open privy and midden system, the report refers to Rochdale, where the movable pan system is best carried out, and states that the loss entailed is

10,000*l.* per annum. In conclusion the Commissioners say: "In our opinion the cleanest and cheapest mode of removing excreta will be by water, through closets, drains, and sewers, to a common outlet. Houses must be drained, streets must be sewerred, so as to remove waste-water, and if these drains and sewers are well and properly constructed, no additional expense need be incurred to transmit the entire volume of excreta from the houses and city, if it is suspended in the waste-water removed from the city, through the mains and intercepting sewers to some outlet. The collection of the city excreta by means of movable pans, or by the process of (so-called) dry conservancy, will cause more nuisance and be more costly than water carriage. The nuisance will be greater, because there will be retention of the excreta for a time on the premises, and the cost will be greater by the amount of labour necessary to collect the excreta, and also because there is no practical mode of converting the excreta into a portable manure which will pay the incidental charges." Mr. Rawlinson distinctly states that his views respecting Dublin applied also to every other town in the country. After quoting the opinion here so strongly expressed by Mr. Rawlinson, denouncing the intercepting system, I think it is only fair to Birmingham to state that one of the Local Board Inspectors, Mr. Harrison, has said respecting the Montague Street operations, that he considers they are and will be a success. I am sorry to be obliged to say that I do not entertain the same opinion on the subject as Mr. Harrison. A great deal has been said about a particular system being the best for universal adoption; that is now an exploded idea. Engineers must conform to the necessities and peculiarities of each place, and endeavour to secure (1) the health of the locality, (2) the purification of the sewage, and (3) the utilisation of it; and to the very best of their ability they must seek to fulfil the first two conditions.

Mr. LYNDE: I heartily endorse all that has been said in condemnation of the intercepting system. When it was introduced into Manchester I was entirely opposed to it, but it was adopted on the suggestion of the Medical Officer of Health. The more I see of the intercepting system, the more thoroughly am I convinced that the water-closet system is the best.

Mr. GORDON: I have only held back from taking part in the discussion because of the peculiar position in which I am placed. I have been resident abroad for a long time, but now am surveyor

for a borough where the pail system is partly in vogue. I consider the non-exposure of the excreta in the pans, as adopted on the Continent, a great improvement upon the open pails we have seen in Birmingham, and which have been adopted by other English towns, and in which everything is exposed to view. It would, however, be difficult to apply the Continental system to England, owing to the entirely different conditions prevailing with us. The pail system, such as it is, is a great improvement upon the old privy and wet ash-pit; but what we have to consider is whether we gain anything by it, as against the adoption of the water-carriage system in its entirety. I am glad to say that in many towns on the Continent the water-carrying system is gaining the day. Dantzic has carried out the water-closet system entirely, and, after years of animated discussion, the same thing has been done at Berlin, and Breslau. At Stutgardt, Munich, and Dortmund, systems of sewers were being carried out according to plans of my own, which were designed for the water-carriage system, with broad irrigation, although the authorities had not yet made up their minds to admit water-closets direct. Well-designed systems of sewers were also in progress in Crefeld, Düsseldorf, and other towns. Frankfort was also a well-known Continental example of the water-closet and water-carriage system, although in the beginning the authorities instructed me not to admit water-closets. The tendency on the Continent, in fact, is decidedly in favour of the adoption of the water-carriage system. As surveyor of a town where 6000 pails are in use, I feel some diffidence in expressing fully my views upon the subject, as you must to some extent consider the views of those by whom you are employed. So far as the Saltley works were concerned they were well designed and admirably carried out; but that did not affect the question of whether it was the right system to adopt. The system was very similar to that at Leicester, where we have also the lime process; but, without any reflection upon my predecessors, or the committee who have charge of the Leicester works, I might say that the Saltley works were in much better order, better designed, and altogether more complete; as no doubt they ought to be, considering that the Leicester works were the oldest of the kind in the country, and those of Birmingham probably the newest on so large a scale. They attained very much the same results, but even at Birmingham the effluent water was not such as ought to be allowed to go into a small river. It was the same at Leicester, where it was possible an injunction might be obtained

against the Town Council any day, when they would have to consider some other scheme for getting rid of the difficulty. It was a question whether intercepting the excreta was worth the cost it entailed. At Montague Street, and the two other places in Birmingham where the process was less perfectly carried on, I understand from the superintendent of the works that something like 900 tons of pail contents were operated upon every week. It was computed that the evacuations of 250,000 persons were dealt with; but according to the average for an adult and children population of that number, the quantity ought to be 1953 tons per week, and not merely 900. Therefore more than 50 per cent. of the evacuations of the 250,000 people were not being dealt with at all. Where did the remainder go to? It must have found its way into the sewers by some mode or other. The explanation was probably somewhat the same as at Rochdale. In the report of the 1876 commission, Mr. Rawlinson stated that only 25 per cent. of the excreta of the population of Rochdale was dealt with by pails. Urine formed a great portion of the evacuations, and no doubt much of it found its way into the sewers from urinals at the various manufactories. Birmingham has 32,900 pails, which if filled brim full would each contain 13 to 14 gallons, but 10 gallons would be a fair average. That would give 1468 tons, or about 75 per cent. of the evacuations of 250,000 people, but instead of that only 900 tons were treated in Birmingham. The excreta from the whole population of Birmingham, taken at 400,000, would represent 3127 tons per week, and the question was, as only 900 tons were dealt with by the intercepting process, whether it was worth while incurring such a large expenditure to deal with such a small proportion of the evacuations of the population. At Saltley about 500 tons of sludge precipitated from the sewage of the town had to be dealt with every day; and he did not think, if they dealt with the whole, that is, if they admitted the whole of the excreta of the town to the sewers, that they would have 50 tons more sludge per day, because not more than 10 per cent. of the excreta would be precipitated in the form of sludge. Notwithstanding the perfection to which the Montague Street works have been brought, it must be admitted that difficulty was experienced in dealing even with the contents of the pails brought there. No one could reasonably object to the system adopted of drying the excreta, and converting it into a marketable commodity in the shape of poudrette, but only 50 or 60 tons per week were thus operated upon, which bore only a very small

proportion to the whole of the collected material. If they were to treat the whole of it thus, the works would have to be considerably enlarged. This would doubtless be the best, because they would obtain an equivalent in the shape of the manure obtained. I think we shall all have learned something from the visit to the Montague Street works. It was undoubtedly a great sanitary achievement to be able to carry on such works, in the midst of a populous district in a large town, without any nuisance being caused to the surrounding neighbourhood.

The PRESIDENT: I consider the discussion has now proceeded far enough, and I will therefore ask Mr. Councillor Martineau to offer any observations in reply which he thinks would be interesting to the Members of the Association.

Mr. Councillor MARTINEAU: I very greatly regret that I have been so busy this morning, that I have been unable to attend and hear the whole of the discussion. I am sorry that I have to appear as the only person prepared to champion the intercepting system; but as one of the speakers expressed a desire to hear some one who could go in "tooth and nail" in defence of it, I have very great pleasure in so far gratifying that gentleman. For convenience, I will first deal with some of the points raised by the last speaker. The quantity of excreta collected in pans with which we have to deal is rather in excess of what Mr. Gordon has stated. The quantity was really about 1000 tons per week; and with respect to the comparatively small quantity treated by the dryers, it must be borne in mind that we consider this mode of treating the excreta rather as an experiment. We are about to erect two more, which, without any material increase for labour or fuel, will turn out a very much larger quantity of poudrette, and the excess will of course be clear profit. When we have these two extra dryers, we shall consider we have then one set of plant complete; and if it then answers, as we feel sure it will, the profit will be very largely increased. I feel sure we shall be able to show the town that the drying process is the most economical method of dealing with the contents of the pans, and that it will only be necessary to increase the plant in order to deal with the whole of the excreta of the town. We, too, regard tips as a great abomination, and the great object we are now aiming at is to treat every single ounce of stuff brought into our yards within the walls of the dépôt. I believe we shall be able to do this. What we now send to tips is really only very small in quantity, but we think we can see

our way to deal with everything, and turn it out as some useful or saleable commodity. The chief objection to the work which I have heard seems to be summed up in the words, "dirty, disgusting, and demoralising." I understand that that is a pretty accurate description of the views of the Association respecting the pan system. As to its being demoralising, I hope that effect has not been exerted upon the committee who has the management of the works. I do not know to what other classes it is considered to extend. I cannot see how the morals of a tenant can be prejudicially affected by an arrangement which is used with such satisfaction every day. One gentleman considers it very objectionable that the faecal matter can be seen when the closet is entered; but I would ask him whether it is not far less visible than in the old open privies, which the pan system has superseded. The Members of the Association must recollect the circumstances under which the pan system was adopted at Birmingham; and, whilst advocating the pan system for Birmingham, I by no means assert that there are not other systems better adapted for other places. Bearing in mind the immense population of Birmingham, and its continuous and rapid growth, you as engineers will appreciate the immense cost it would have entailed to obtain sufficient land to treat properly the whole of the town sewage, if there had been no other system than water carriage. It has been said by one speaker, that if the intercepting system were abandoned, he did not believe there would be 50 tons more sludge to be dealt with daily at the Saltley works. There must surely be some miscalculation here, as about 1000 tons were treated by the intercepting process every week. The seventh part of this would be nearer 150 than 50 tons additional to be dealt with daily at the Saltley works, and 150 tons per day would add considerably to the expense of the latter. I began with "demoralising"; I will now go back to the "dirt."

After describing the way in which the pan is cleansed, and the mode in which it was rendered air-tight, Mr. Martineau said: Not a drop of the contents can escape, and I affirm there is not the slightest smell whilst the pans are being removed. The pans are charged at night, and I have frequently followed the carts, and it was exceedingly rare that I have ever been able to detect any offensive smell. You will all admit this is very different from the horrible nuisance and stench occasioned by the emptying of ash-pits and privies, which the pan system superseded. I would ask which was the more "dirty" of the two systems—the quick removal of the

pan, without smell or annoyance of any kind, or the emptying of an ash-pit, which created a disgusting nuisance throughout the entire street, often accompanied by a noise which rendered sleep impossible.

Mr. LEMON: Before Mr. Councillor Martineau arrived the discussion was rather as to the superiority of water-closets over pails. We wholly disbelieve in ash-pits, as things not to be tolerated at all by sanitarians.

Mr. MARTINEAU: With respect to water-closets, I have no personal experience of their application to large towns, but from what I have observed in well-to-do houses where water-closets are used, I should think it must be a matter of the greatest difficulty—in fact I should say almost of impossibility—in the poorer quarters of a town to keep water-closets in such order that smells from them should not enter the house. Even in well-constructed houses, where there was plenty of ventilation, a nuisance was occasioned whenever the valve got out of order, and during frosty weather this was very liable to occur. How closets could possibly be kept in order where people were so very careless as we know them to be, and were alike ignorant and indifferent respecting sanitary matters, is to me a mystery: so much for the dirt. There was a good deal of prejudice against them before the pans were fixed and actually in use. I have made numerous inquiries amongst the poor as to how they liked them, after the pans had been some time in use, and the replies have invariably been that, whereas the ash-pit used to be constantly smelling offensively, there was no nuisance whatever from the pans. I think such testimony valuable; and the allegation that the distribution of the miscellaneous refuse collected at Montague Street tended to disseminate disease can be answered by statistics. The system has been in operation for eight or nine years, but has come into more general use during the last four or five years. If it were true that it was the means of disseminating disease, the more the system was extended the more the evil would be augmented. The medical officer's reports gave the death-rate for the past year as 20·49, whereas the average for the ten previous years was 24·04. The deaths from zymotic diseases last year numbered only 3·2, whilst for the preceding seven years the average was 5·2. I do not claim that the whole of this diminished mortality is due to the adoption of the pail system. We owe a great deal also to the superior cleansing of the streets and pavements, and I do not

wish to ignore the efforts made by the Health Committee to perfect the sanitary arrangements of the town, but I would say this, that the death-rate would never have been reduced so low if we had adhered to the old ash-pit system previously in existence. One speaker said it was very disgusting that from week's end to week's end these pans, receiving the evacuations of the whole family, should be standing in one of the out-buildings of the premises. This seemed to be due to misapprehension, because the pans were collected with great regularity every week, and it was found that within a week the contents did not become offensive. The water system has been generally praised by the Association, but whilst it may be suitable for some places, the advocates of water-closets would perhaps admit that the circumstances of Birmingham were different from those of other towns. Birmingham is increasing very rapidly, and land is becoming greatly augmented in value in the neighbourhood of the town; besides, to change from the pan system to the water-closet system would at the outset be exceedingly expensive, and I really do not know how it could be done. Then an enormous acreage of land would be required for the proper purification of the sewage, and taken altogether, I think the water-closet system would prove more costly than that now in use.

The PRESIDENT said the intercepting system was undertaken by the Birmingham Town Council at a time when they were in great difficulties through Chancery proceedings instituted by Lord Norton. It was absolutely necessary for the Council to do everything they possibly could to remedy what Lord Norton complained of at Saltley. The Council had lost their Bill in Parliament, and were consequently unable to purchase additional land. It was therefore thought desirable to adopt the lime process at Saltley, and the present intercepting system. One or two questions had been asked, which he should be happy to answer. Mr. Lynde inquired at what speed the water flowed, in order that the sewage sludge might be deposited, as seen by the Members of the Association at Saltley. The velocity through the larger tanks was about 30 feet per minute, and through the smaller ones somewhat less. Another gentleman inquired whether there was any deposit in the sewers, and whether they had ever to be cleansed. We have had to do so in three instances, where the gradient was about 1 in 800, and where the storm-water from macadamised streets, with gradients of 1 in 15 and 1 in 20, rushed down with great

violence, carrying also with it quantities of detritus from the road. When the additional land was obtained it was not intended to take out so much of the sludge; all that would then be necessary would be to take out the heavy detritus in the first division of the first tanks. With respect to the pail system, though he was far from being an admirer of it, yet, with Mr. Martineau, he held that it was a far better system than the privy system, which formerly existed.

Mr. MARTINEAU: Mr. Gordon meant they would only have fifty additional tons of sludge to deal with at the Saltley works, if the intercepting system were adopted. I therefore withdraw my imputations upon Mr. Gordon's arithmetic.

The PRESIDENT was sure Mr. Martineau would answer any question respecting the discontinuance of the intercepting works at Shadwell Street.

Mr. MORANT: We understand the Shadwell Street works are discontinued merely because the Medical Officer of Health thought they might be some nuisance to the hospital.

Mr. MARTINEAU: I am bound to confess there was a little nuisance, I believe, from Fryer's Carboniser, the use of which was discontinued. The committee did not consider there was any nuisance from it, and it was only discontinued because of the proximity of the hospital.

On the proposition of Mr. LEMON, seconded by Mr. LEWIS ANGELL, a vote of thanks was unanimously accorded to Alderman Avery, Mr. Martineau, and the members of the Sewage Committee for their kindness and courtesy to the Members of the Association.

ANNUAL MEETING AT BIRMINGHAM,

July 7, 8, and 9, 1881.

THE SANITARY AND CONSTRUCTIVE
SUPERVISION OF DWELLINGS.

By LEWIS ANGELL, M. INST. C.E., PAST PRESIDENT.

THAT "an Englishman's house is his castle" is a fondly cherished tradition. Be the Castle one of Indolence, Ignorance, Dirt, or Disease, who dare invade it? But a castle means isolation, a separation of neighbours by walls and entrenchments; and so long as the lord thereof and his retainers remain within the keep, their doings do not concern the outer world. But if the garrison sallies forth, committing devastation, are not the attacked justified in invading the castle? "Self-preservation is the first law of nature;" and if sanitary science, unknown to our mediæval ancestors, has taught the modern Englishman that the safety of his own well-ordered castle is dependent upon his neighbour's being also set in order, surely the most radical opponent of paternal government will concede that freedom must be qualified by the moral and physical rights of our neighbour.

One of the earliest applications of this principle of compulsory sanitation was in the Vaccination Acts. Legislation also prohibits the exposure of infected persons and clothing. More recently the principle has been extended by local Acts requiring that the various kinds of infectious disease shall be reported to the Medical Officer of Health. The extension of sanitary supervision to dwellings is therefore not only in harmony with established principles and precedents, but is, in fact, a demand which has found expression in the recent establishment of societies in London and Edinburgh for sanitary inspection on co-operative principles. The latest

development of the movement is the "London Sanitary Company," an association of eminent sanitarians who propose to combine philanthropic principles (limited) with the business of a big plumber. The Company contemplates, as a "moderate estimate," an annual receipt of 10,000 guineas from 10,000 houses, independently of "entrance fees" and the profits from plumbing. The skilled advice of the highest medical and sanitary authorities will be secured, surveys and reports made by "an efficient inspecting staff acting under the direction of the Company's engineers." The Company will put dwelling-houses in a perfectly sanitary condition, filter water, cleanse cisterns, prevent boiler explosions—in fact, sanitary repairs of all kinds will be "neatly executed at the shortest notice." A dividend of 20 per cent. is suggested by the prospectus, and $7\frac{1}{2}$ per cent. guaranteed by the plumber whose business has been acquired by the Company as a "going concern," and whose services the Company have been fortunate enough to secure as "managing director."

It is to be regretted that the aspirations of the Company should stop short in so great a work. Surely ratepayers would not object if the Company would also take over Local Boards as a "going concern," and guarantee a dividend, however small. A guinea rate per house per annum officially levied by the sanitary authority would very much more than maintain an efficient and responsible staff of sanitary inspectors, who would extend their protection to the poor as well as to the well-to-do subscribing shareholders, whom alone the "Sanitary Company" proposes to benefit.

The fact of the existence of such societies, be they due to philanthropy or stockjobbing, raises a great question:—Is such sanitary supervision necessary? and, if this be granted, by whom should it be conducted?

That supervision is necessary will be admitted by all who, like the Members of this Association, have had any official experience. Thousands, probably hundreds of thousands, of houses are annually put together, we cannot say built, in such manner as to be dangerous to the lives of the occupants. Not only is stability disregarded, but every essential principle of sanitation ignored; the water-pipes, the drain-pipes, the very site frequently a huge dust-bin, form a combination of contaminating influences which lower vitality and endanger life. This result is due as much to ignorance as to carelessness, a concourse of fortuitous evils rather than a conspiracy, although one regrets to have to add, as the result of official

experience, that in too many instances it is also the result of the most wilful and wicked cupidity.

As a practical illustration I may be allowed to quote my own official experience. For more than fourteen years past I have had the supervision of by far the largest district in the country governed by a Local Board; all other places of its size, and very many smaller, have Municipal Corporations. I refer to the district of West Ham, in Essex, which forms part of the "outer ring" of "Greater London." It includes nearly 130,000 inhabitants, having more than doubled during the last ten years. Some 14,000 houses have been put up during my term of office, and at present they are increasing at the rate of about 2300 per annum, equivalent to a new street of nearly 200 houses per month. These buildings require supervision. Being "over the border," we have no building fees as in the metropolis, a fact which induces the speculating builders to come over. If only a guinea were charged on each building—only *one* guinea, not the *annual* guinea invited by the "Sanitary Company"—my Board would, independently of the rates, derive an income which would enable them to provide a qualified and responsible supervising staff not only to enforce the proper construction of new buildings, but to discover defects in old ones.

The Local Government Board recently issued a series of model bylaws for buildings, involving very much detail; the advantage of their adoption was manifest, but adoption and observance are very different matters. I would have gladly urged their adoption by my Board had I not also felt there was no chance of their general observance over a district of $7\frac{1}{4}$ square miles with the staff I had at my disposal. The matter was so represented to the Local Government Board, and the imposition of building fees urged so as to provide a staff to carry out the bylaws; the reply was a courteous promise of consideration, but hoping in the meantime their "model" would be adopted. To this day the Local Government Board has done nothing to assist the officers, neither has my Board adopted the bylaws, for I hold it is bad policy to enact laws which cannot be enforced, which will be observed only by respectable and entirely disregarded by "jerry" builders. The infliction of penalties here and wholesale escape elsewhere is suggestive of official favouritism, and I maintain that we had better be without such minute laws than to bring them and the officers into disrepute and contempt by their habitual infraction. It is not,

therefore, out of any want of appreciation or spirit of opposition that West Ham has not adopted the model laws of the Local Government Board. The moment the means are provided to maintain a staff for their observance, their adoption is certain.

And here, in passing, I cannot refrain from giving public expression to a feeling present in the minds of every Member of this Association. As public officers, the Local Government Board impose their obligations upon us, they favour us with their criticisms, but in no single thing do they either consult, assist, or protect us.

When an epidemic breaks out, locally or generally, one of the first suggestions made by sanitary authorities and local newspapers in their panic is to institute a house to house visitation; but, in fact, it is seldom attempted, and never effectually done, because it means expense, the ordinary staff being as utterly inadequate for such extraordinary efforts as it generally is unequal to ordinary requirements. But, whatever the extent of staff, the Local Authority has no power of inspection unless there be knowledge or reasonable suspicion of the existence of a special nuisance. In any case, the power of entry can only be enforced after compliance with certain formalities involving time and trouble; on the other hand, be the householder ever so anxious as to his safety, he cannot, of right, require an official inspection of his premises unless a nuisance is known or suspected to exist. However serious may be an epidemic, sanitary officers have no power to make house to house inspections.

It does not appear to be unreasonable that local authorities should have the power during epidemics as well as at all reasonable times, on reasonable grounds, to make house to house inspections, or that the ratepayers should, at all times, have the right to require such inspection. A short amending clause in the Public Health Act would readily effect all that can be reasonably expected. But to give effect to such power and satisfy the periodical demand, would impose on the local authorities the obligation of employing a sufficient staff of qualified engineering and sanitary officers. At present, at the best, sanitary inspection is not exercised in any sort of systematic manner,—houses are built and drains are laid, especially, as has been said, in the suburbs of London, practically without effective supervision; and why? not for want of power, but because of the paucity of the engineering and sanitary staff. The public are not sufficiently educated in the importance of sanitary principles

to induce them to consent to the payment of the necessary staff out of rates, but, as already shown, there is an equitable way by which ratepayers may be relieved of rates and reconciled to the existence of officials, viz. by putting the burden on the right shoulders and imposing fees upon the chief offenders against sanitary laws—those who build houses and derive profit therefrom. Such fees would, of course, go to the Local Authority, and not, as in London, to the District Surveyor.

Some years ago local bylaws required a certificate to be given before any new house was occupied, but the clause has been expunged by the Local Government Board as *ultra vires*. If fees are imposed by legislation, it should also be enacted that an official certificate should be granted on the satisfactory completion of a dwelling-house. Such a certificate would be of real value, inasmuch as no one need then occupy a new house without its production. Sanitation would thus become a real increment of value in house property.

Impressed with these views I have, for years past, urged them, in season and out of season, long before the conception of the new limited sanitary *quasi* philanthropic companies. Some sixteen or seventeen years ago I joined in a memorial to the Home Secretary to enable local authorities to provide by fees for the proper supervision of buildings. A few years later I wrote to Mr. Gladstone on the subject, and he courteously promised to forward my letter to the proper department. For years past I have urged my own Board and others to obtain Parliamentary powers to charge fees, and last year such a clause was included in a Bill promoted by the West Ham Local Board. There was no opposition, local or otherwise; the Local Government Board not only did not object, but officially recorded its opinion that the circumstances of our case were so exceptional as to justify the application. The metropolis has long had such powers, Bristol has for forty years, even the little town of Eastbourne has such powers. With these precedents, and such exceptional reasons, a Committee of the House of Commons expressed its willingness to hear our case, and waited for our evidence; but a power greater than Parliament, an *imperium in imperio*, put a veto on our clauses, and ruthlessly struck them out; this omnipotent power, Lord Redesdale, totally ignorant of the place and the circumstances, is governed by the abstract idea that powers outside the Public Health Act should not be given to local authorities,

totally disregarding the fact that every session exceptional powers are given to local authorities throughout the country in accordance with their varying necessities. No less than fourteen towns have recently obtained independent and varying local Acts for the report and registration of infectious diseases, such as small-pox, typhus, scarlet-fever, &c. Why, in the name of all that is "abstract," should these fourteen towns be granted such exceptional powers not included in a general Act applicable to all towns? Why should Eastbourne in 1879 obtain the powers which are refused to West Ham in 1881? Because, replies my Lord Redesdale, "exceptional circumstances" exist at Eastbourne. Eastbourne being a pleasant resting-place from Saturday to Monday, I took the opportunity of investigating the "exceptional circumstances." A large part of the town is owned by the Duke of Devonshire, the very streets are called "Hartington," "Cavendish," and other of the family names. The Duke's local agent is a leading member of the Local Board and, whether or not he will acknowledge the soft impeachment, has the credit of obtaining the recognition of the "exceptional circumstances" applying to the pretty houses of ducal Eastbourne and those who dwell therein during "the season." That any circumstance exists, "exceptional" or otherwise, in Eastbourne which has not tenfold force in West Ham is distinctly challenged. In short, the few hundreds of the upper and middle classes who visit the toy-like town of Eastbourne are to be more exceptionally protected in their temporary dwellings than the thousands of toiling factory artisans who are compelled to live all the year round on the Essex marshes.

My present object is not to discuss the wrongs of my own district, but to illustrate, by a typical case, the difficulty local authorities have to encounter in an honest and reasonable endeavour to cope with a great evil and promote sanitary well-being. Here is a case in which an efficient supervision of the operations of building societies, speculating builders, and their accessory works requires an addition of some half-dozen inspectors to the local staff. "Pay them out of rates," say abstract legislators, "it is a municipal obligation;" but we municipal engineers and surveyors know too well the difficulty of obtaining decent payment for our own services to expect a sufficient assistant staff. Large towns like Liverpool, Manchester, Birmingham, or Leeds may provide the necessary staff ungrudgingly, but it is not so everywhere. And why should such burdens be laid on the rates? Estate owners and builders

are working for their own interests, many making large fortunes.* Why, therefore, should they not contribute a fee, small in itself but large in the aggregate, to provide the supervising staff which their pursuit of fortune necessitates? Because, we are told, they are already adding to the rateable value of the town; if so they also receive, in common with others, the full value for their rates; but, as a matter of fact, such increase of buildings does not lessen the general rates, inasmuch as it involves a proportionate increase in the maintenance of roads, sewers, lighting, scavenging, police, &c., not to mention the School Board and poor-rates generally attending on the increase of a population.

While abstract legislators devoid of practical knowledge are speculating, speculating builders are working, thousands of houses have been put up, and thousands more will follow before there will be any efficient control under a "general" Act. Imperial Parliament has no time for such trivial local matters. Surely there is as much necessity for "Home Rule" in England as in Ireland.

Perhaps some of the Members of this Association will not assent to the full extent of my assertions. It is obviously derogatory alike to our pride and our efficiency as public officers to admit it, but I unhesitatingly assert, as the result of a long and varied private and official experience, that however good our local bylaws, and however anxious and capable our local officers, as a matter of fact there is no large town in Great Britain where, in its true meaning, sanitary supervision is efficient.

Having quoted my official experience, I will crave a like indulgence in my private capacity in illustration of the defects of *old* houses. I have just entered a new residence; the house is not new, but a good, substantial, well-built family dwelling of the last generation. In it there are as many as four cisterns; in that from which the drinking-water is drawn sewer-gas was "laid on" by no less than three "services" or direct connections with the house-drains, viz. two flushing pipes to water-closets and an untrapped overflow into the drain; each of the three pipes supplied sewer-gas for absorption by the potable water; another cistern had two connections with the drain, a closet flush and an overflow pipe; a third cistern was also connected with the house-drain by an untrapped overflow pipe; but curiously enough the fourth

* It was only last week that the Master of the Rolls, in giving judgment in a certain case, said, among other caustic remarks, "We are not to sacrifice the interests of the public to the interests of the speculative builder."

cistern, not intended for the supply of drinking-water, was the only one unconnected with the drains. There were also two sinks in communication with the drains. In fact, within the house there were no less than nine drain connections with sinks and cisterns, exclusive of water-closets.

All this was altered at considerable trouble and cost, much greater than if correctly done at first. No sewer gas can now enter the house or contaminate the water. The new arrangements were regarded as "fussy," and sarcastically described as "very scientific," and as a further comment upon the sanitary theories thus practically asserted was quoted the fact, which is undoubtedly true, that in the same house the preceding family had for very many years lived very healthy lives. The obvious reply is that, according to all the laws of sanitary science, the inmates of such a house *ought* to be ill; under such conditions escape must be due either to the "survival of the fittest," that is, the inherent resistance of robust constitutions, or to the protection of a special Providence which cannot be tempted with impunity, for those who know the law and disregard it may expect and deserve "to be beaten with many stripes."

Let me quote another case or two. In the civic palace of the Lord Mayor of London, three-quarters of an inch of floating fungi scrub was recently found on the surface, and three-eighths of an inch of mud at the bottom of the cisterns, while a bottle of water on his Lordship's table contained hundreds of nematoid worms. Nor is the West End of London better than the City, for in the cistern of the Athenæum Club, St. James's, was found a large quantity of offensive mud and animal organisms. The discoveries as to the insanitary condition of the Government Offices are only too notorious. In poor neighbourhoods and small houses, the water-butts and cisterns, especially in London, are situated in close courts and contiguous to every kind of filth; generally placed over the water-closet, near a sink and dust-bin, untrapped pipes communicate directly from the cistern to the soil-drains. They are frequently uncovered, consequently the water absorbs the impurities of the surrounding atmosphere; they are not cleaned out from one year's end to another, so that they accumulate mud and slimy vegetation.

But it is unnecessary to multiply instances, or enlarge on the existence of evils so well known to us sanitary officers.

To a condition of things such as above described, in houses new

and old, is undoubtedly due the lassitude, the illness, and the death of thousands whose inherent power of resistance is unequal to the fight. Those who are subject to such influences stand very much in the relation of the unvaccinated to small-pox: they *may* escape, but the chances are obviously against those who neglect the protection so well known and so easily attainable.

I think it has been sufficiently proved that sanitary supervision is needed in our dwellings, and that it is equally obvious the work should be a public and an official one, and not undertaken by amateur or stockjobbing companies whose philanthropy is confined to shareholders. That the work has not been done before is not the fault of us officers; that it can be done, if paid for, is the very argument on which the companies are founded; but that shareholders should be protected and the poor neglected is a proposition too monstrous to be discussed. Sanitary protection is the legal right of all without subscription or "entrance fee" beyond the obligatory general charge of rates. We have seen how means can be provided without increasing the rates by charging the costs on those who can and should provide them. Surely fees are sufficiently recognised in England: from a railway station to a Government office, can any information be obtained or act done without a fee? Why a fee should be imposed on every new house in London, Bristol, and even little Eastbourne, with admitted advantage, but no other town should share in such an advantage, is inexplicable, unless it be to leave an opening for a new development of commercial enterprise in the formation of Sanitary Protection Associations (Limited). It is true that an Englishman does not like officialism. We know, by experience, that it is in his nature to put himself in a fighting attitude towards officials, but if we must needs have officers, it is better to have the responsible officer of a legally constituted and recognised authority than irresponsible employés of a limited liability company. It is a disgrace to our legislation that in England, the cradle of sanitary science, there is room for such companies. We read in the *Sanitary Engineer* of New York:—

"Chicago has found the results of her system of factory inspection so beneficial that she is now applying it to tenement houses. Six inspectors are now making a critical inspection of the tenements, and will continue it until the 7000 tenements which, according to the *Chicago Times*, there are in the city, will have been examined. The *Times* says that the work has now been reduced to a system, and complete records are kept of all work done. These records

consist of date, location, ward, district, name of owner or agent, description of building, number of rooms, number of families, with the number of persons in each, sanitary condition of the building, action taken in abating nuisances found, and explanatory remarks. Each inspector is provided with blanks, which he fills out at the close of each day's work. His report describes the condition of the plumbing, drainage, the local sanitary condition, and notes any violations of the city ordinances. In case anything is found about premises which is detrimental to health, a notice is served on the owner or agent, who is required to comply with the ordinances of the city relating to the abatement of nuisances."

We also read that in New York and other States household plumbing is placed under official inspection. This is the outcome of more advanced public opinion in America. I have already hinted that the British ratepayer is not yet sufficiently educated in sanitary principles; he does not yet appreciate the maxim that "Prevention is better than cure," that it is very much cheaper to employ a few inspectors than to pay the rates consequent upon preventable disease and the untimely death of the humble breadwinner.

I therefore submit the following propositions:—

That a more efficient and extended supervision of the sanitary and constructive details of all dwellings is necessary.

That such supervision should be conducted by the responsible officers of the local sanitary authority.

That it is just and expedient that fees be imposed on all new buildings, to provide the cost of such supervision.

In conclusion, we must hope more from education than officialism. If sanitary science were studied in our schools, and our youth taught to avoid vitiated air as they would false quantities; if elementary hygiene were recognised as equal in importance with simple equations, many a good and useful life would have been saved for the commonwealth. But now, in the selection of a house, more attention is given to a "dado," a "cornice," and "æsthetic" ideas, than to the cistern, sink, or other vital conditions of health. How difficult even is it to obtain compliance with the most simple and obvious sanitary rules in one's own house! For example, whatever may be the radical defects of construction, sewer gas may at least be neutralised and kept out of the house by always keeping the closet door shut and the window open; but we almost invariably find the reverse rule to obtain, the window is *shut* and

the door *open*, especially at night, when the house is almost hermetically sealed, and a current of sewer gas, induced by the warm air, enters our sleeping-room at a time when our powers of resistance are at their lowest. In large hotels we find at the end of a long corridor of bedrooms a battery of closets with every window shut and every door open, unless some "fussy" people, like ourselves, take the trouble to reverse the arrangement by opening the windows and closing the doors.

It is unnecessary to say more. The canon laws of house sanitation are very simple and easy to observe. Builders will say that "Doctors differ"; it is not so; there is no differing upon general principles; they are so well known to every Member of this Association, that it is unnecessary to state them, but for the advantage of the general public I may be excused for repeating some of the more important of them. There should be no connection between the house and the sewers excepting for sewage; the soil-pipe should not by any chance ventilate itself into the house; all other drains or pipes from cisterns, baths, lavatories, sinks, &c., should discharge into the open air; the drinking-water should have no connection with the closet. These are cardinal rules, the neglect of which may be fatal; but nearly every one can discover for himself such neglects. There are, of course, other matters more difficult to detect.

We have only stated principles and facts, well known to all sanitarians, which have been repeated over and over again. But sanitarians are few and the population is large; the population is also careless, and it is not until an unexpected, cruel, and irreparable death has smitten a family with deep affliction, that conviction is forced upon the survivors, and alas! when too late, they recognise preventable causes and adopt the simple precautions and protections which, at present, are almost exclusively the privilege of the occupants of workhouses and jails.

DISCUSSION.

MR. VAWSER: I acknowledge that Mr. Angell has made a strong case in support of the somewhat peculiar views he has brought forward—that Corporations and Local Boards should have power to levy building fees, in order to provide efficient supervision over new buildings, but I hold that such an arrangement is neither practicable nor desirable, and that it is the imperative duty of local

authorities to provide out of other funds at their disposal a sufficient staff of sanitary inspectors to carry out any supervision which may be necessary. I have no doubt most surveyors will agree with Mr. Angell that the supervision in many cases is inadequate, but I do not think that fact will justify the engineer of a local authority advising the authority not to adopt suitable by-laws. Mr. Angell has told us that by his advice the West Ham Local Board has not adopted the bylaws suggested by the Local Government Board, simply because his Board will not provide the supervision necessary to enforce such bylaws: I think a surveyor incurs greater responsibility by advising an authority not to adopt these bylaws, than he would by advising their adoption, and then showing that he is unable alone to carry them out. It was the business of a surveyor to organise a system of inspection, and generally to see that all buildings were properly constructed; but I do not suppose Mr. Angell would consider it necessary to have scientific men to look after details, as a number of practical men, acquainted with the different kinds of work, could be employed for this purpose. Mr. Angell should endeavour to induce his Board to undertake the connection of all house drains with the sewers, as was done in several towns, with very great advantage to all parties, and thus remove one great cause of complaint. Where only one surveyor was employed, it was impossible that there could be efficient supervision, and they all would readily admit that efficient supervision is a matter of primary importance.

Mr. ELLICE-CLARK: I am somewhat disappointed with the paper, inasmuch as the author does not enter into those details which are absolutely necessary in carrying out a system under stringent bylaws; and this is more to be regretted, because Mr. Angell has spent a long life in various parts of England administering municipal, statute, and bylaws, and therefore having an almost unique experience—in having been engaged professionally during the whole period which had elapsed since the inception of Public Health Acts—and also having charge of a district growing with such giant strides as West Ham. I dissent altogether from the last speaker, that a surveyor should advise his Board to adopt a series of bylaws they could not carry out. Where such bylaws are adopted, not only do certain of them fall into desuetude, but it is calculated to bring the whole into contempt. I therefore think the West Ham Board has shown great sagacity. They have adopted bylaws which can be enforced with reasonable super-

vision; but, if the model bylaws had been adopted, Mr. Angell would have required four or five assistants. London and Liverpool have for many years exercised municipal supervision over dwellings, but until quite recently in most towns it has been left to the individual. Great difficulties have been encountered, and still have to be overcome, before an effectual supervision can be exercised throughout the country. Every grade of supervision is exercised, from that of daily visitation by the building inspectors, under the model bylaws, to absolute indifference on the part of officials, without bylaws worth the name. It would be impossible in some towns to insist on stringent sanitary provisions, however necessary, but it should be the aim of the municipal surveyor gradually to work up to the standard required. As most modern bylaws enact that the surveyor shall give a certificate that each house has been built in accordance with the requirements of the bylaws, before he can conscientiously give such a certificate, or if it is to be of any value, the house must be inspected during every stage of its progress. Mr. Clark quoted a complicated bylaw out of the Hove Code, where 103 distinct matters must be supervised, dealing with minute details relating to buildings, and observed: The property erected at Hove during the last five years exceeded a million sterling in value, so it is manifest that anything like the supervision required before a surveyor could give a certificate of compliance with the bylaws, could not be carried out without a large staff of experts, paid sufficiently to place them above temptation. If supervision were to be of any value whatever, it should be exact and impartial. If coercive laws were to be carried out, no discretionary power should be left in the hands of local authorities or officials. Such discretionary powers are open to great objections, especially where the bylaws are administered by irresponsible committees, some of whom were themselves subject to the laws. Laying down hard and fast rules might cause injury to individuals, but none to the public. If discretionary power were exercised favourably towards one individual, no prosecution could justly be instituted against another offender. I agree with Mr. Angell that bylaws which cannot be enforced should not be adopted, and if stringent bylaws are to be enforced, nothing short of a daily inspection of each house would be satisfactory. Public opinion is hardly yet ripe for such a change as Mr. Angell advocates. It, however, appears to be an equitable charge on a building, and the fee is very low compared with the aggregate

cost of each house. In the metropolis, precedent could be cited in its favour; and it is difficult to see how Parliament can refuse its assent to the principle being extended to the whole country. Another point deserving of attention is the probable effect upon the community at large if detailed bylaws are stringently enforced. It may be fairly assumed there would be a higher state of health, morality and civilisation; indeed, this has passed into a law beyond the region of discussion. But, in exercising something akin to parental control, we must take care that individual responsibility is not removed from the shoulders of builders and workpeople to those of officials. Whatever restrictions are placed on building, or whatever supervision is exercised, it must always be borne in mind that the condition of a building is the responsibility of the builder.

Mr. PARBY: It would be perfectly useless to carry out the model bylaws unless the supervising staff were greatly increased, and there is great indisposition on the part of corporations, especially if they are not rich, to multiply officials. At Reading a guinea a house would provide sufficient inspection; but without efficient inspection it is useless to adopt bylaws dealing with the details of building construction. Considering the advantage builders get, I do not think public authorities should provide the staff necessary to ensure the minute details in the model building bylaws being carried out at the expense of the ratepayers.

Mr. LYNDE: For many years we have had efficient supervision at Manchester, without any cost to the builders, embodying all the points to which Mr. Angell has alluded. The drains are all inspected before the trenches are filled in; the water fittings, the size of the rooms, and ventilation are all examined, and the certificate of the surveyor must be obtained before a house can be inhabited, or a heavy penalty would be incurred. I consider it would be objectionable for fees to be paid. I object altogether to fees being paid, because the inspection is as much for the benefit of the public as any other part of sanitary work, and should therefore be paid for out of the rates.

Mr. ASHMEAD: I agree with Mr. Angell that the right person to pay for supervision of a building was the builder who erected it. At Bristol we have a special rate, according to the class of house, and we have received as much as 700*l.* a year in this way. Every detail of a house is examined except the water fittings. We en-

force these fees under an Act of forty years' standing, and the surveyor's certificate must be obtained before any house can be inhabited.

Mr. LEMON: I do not think any supervision efficient unless done during the building of the premises, and it should be undertaken by the sanitary authority. We all admit there should be such supervision; the only question is, the staff necessary to carry it out. I prepared a most stringent code of bylaws, respecting which I read a paper at the last meeting of the Association in Birmingham, but my experience has been, that I have never been able to get a sufficient staff to carry them out efficiently. One provision was, that the surveyor was to give a certificate that the whole of the conditions of the bylaws had been carried out to his satisfaction; I never could do this, and I never have. Mr. Angell has adopted a very prudent course by advising his Board not to adopt the model bylaws until they had thoroughly made up their mind to carry them out. One important defect even in these bylaws is, that they give no control over the plumbing work. We all know the serious evils which arise from the want of such control. I do not like the idea of builders paying fees to any officer, because it rather exposes us to temptation. It is true the fees might be paid direct to the Board, but I agree with Mr. Lynde that the payment of fees would be very objectionable. The surveyor should be the responsible officer, and when a bylaw is infringed in any way, he should summon the offending builder before the magistrates on his own responsibility. It is wrong in principle that a surveyor should have to report to a committee any infringement of a bylaw, because the offender might really sit in judgment on himself. I once summoned a member of my own committee and got him convicted, but it did not do me any good, and I cannot advise any of my hearers to try the same experiment. The system of summoning through a committee, I repeat, is open to great objection and abuse. An Act would be necessary to confer power to charge fees, but it would be better that it should not be an unopposed bill, otherwise it would fall into the hands of Lord Redesdale, and then it would be most seriously mangled. Lord Redesdale, as Chairman of Committees, exercises a supervision over unopposed bills which is most injurious to all true progress. This is not merely my opinion, but the opinion also of most persons who have thought on the subject. What right had the Chairman of Committees to strike

out clauses on his own *ipse dixit* without hearing argument? He was called the Chairman of the Committee, but the fact was that Lord Redesdale was the Committee itself. The question of fees was one which should be dealt with by the Legislature. They might lay down a few rudimentary principles, and let Parliament impose small fines for any infringement of them.

Mr. MORANT: Very stringent bylaws have been adopted in Leeds within the last three years, and the Corporation largely increased—more than doubled—the staff of building inspectors. A certificate is given when a house is completed satisfactorily, and when the bylaws are infringed the offenders are summoned before the magistrates. I have a very strong objection to fees, because however straight we might be, there is always the danger of an imputation that we might take a bribe or show favouritism.

Mr. SPENCER: I am glad that this question has been brought forward, because I am certain that it requires a great deal more ventilation than it has yet received. The towns which have building inspectors are comparatively few. For small towns, or for those even of medium size, say up to 30,000 or 40,000 inhabitants, there is no such officer, and the duties are thrown upon the Borough Surveyor, and I believe form a part of his duties which are very seldom perfectly carried out, simply because he has not a sufficient staff to do the work. I fail to see the justice or force of a single argument brought forward in opposition to the payment of fees by builders. If they were paid through the Local Board or Corporation, and passed through the hands of the Borough Accountant, I cannot see how there could possibly be any invidious feeling respecting them. If a builder had to pay for road making or flagging in front of his houses, why should he not also pay a guinea for proper supervision being exercised over a building during its erection? It comes under the same class, and might easily be included in the same category. It is quite impossible for a town surveyor himself to inspect every house erected during all stages of its progress. I am surprised at the sentiment expressed by Mr. Angell with respect to the model bylaws. They are theoretically correct, but in practice are not feasible. In fact I know of codes of bylaws, almost identical with the model bylaws, which have been returned so mangled and mutilated that it was found quite impossible to adopt them. I know of one case where the model bylaws were actually sent up unaltered, and

returned with marginal notes for the Town-clerk to answer,—“What authority have you for this?” and “How do you propose to justify this?” This arose, I presume, from the Revising Barrister of the Local Government Board not knowing that the bylaws emanated from the department.

Mr. BOULNOIS: I have not recommended my Corporation to adopt these bylaws, not only because it would be difficult to enforce them, but because they are not applicable to all towns. Clauses which might do for the metropolis are not suitable for provincial towns. If bylaws are made very stringent, I think they frequently defeat the object for which they are framed. Builders very often evade bylaws, and by beginning at the top manage to raise so many difficulties that it is impossible to prove that the structure is a new building. I should like to know what staff is employed in Manchester to ensure every house being thoroughly inspected during erection. No doubt a surveyor is often placed in a difficult position when he has to report a member of his own Board or Corporation for infringing the bylaws as a builder. Now I know as a fact that the Local Government Board does not intend to afford any protection to town surveyors, because they consider that a surveyor who is at variance with his Corporation or Board in any way should not continue to hold office. That is the only reason the Board assigns for not giving a surveyor that protection which he ought to possess, if he was faithfully and fearlessly to carry out his duties.

Mr. LYNDE: In Manchester the sanitary work is divided into different departments. The Waterworks Committee is responsible for all fittings, which are examined and stamped before being used. The drains from a building to the sewers are under the charge of the Paving Committee, whose surveyor looks after that branch, sees to the sewers and general ventilation of the building, and that it is carried out generally in accordance with the plan deposited at the Town Hall. The Building Surveyor has one or two assistants under him, and the Paving Surveyor has also one or two assistants. The city is divided into districts, and they experience no difficulty in carrying out the bylaws.

Mr. MORANT: I have four building inspectors and two office clerks, and there is a surveyor in my office who sees to levels and lays out new streets. The aggregate cost of this staff is about 800*l*. There is another inspector who sees to flagging the streets and the sewerage of all new estates, because under the

Local Act all such work must be done by the Corporation. After a house is finished, the paving and flagging are seen to by another inspector.

Mr. ASHMEAD: At Bristol four inspectors, one assistant, and two office clerks are employed, at a cost of about 800*l.* a year.

Mr. GORDON: I think the model bylaws more adapted to London than to the provinces. At West Ham, some years ago, I have seen flooring-boards used as joists, and mud scraped from the roads to mix with lime as mortar, whilst the foundations were put merely upon the soil. The result was that the walls of houses that had been erected only four or five years cracked, and became quite dilapidated in appearance, more especially when the sewers withdrew the water of the subsoil. If the model bylaws were applied to a provincial town, I am afraid a surveyor would find it difficult to induce his Town Council or Local Board to produce the requisite assistance to ensure their being properly carried out. Each should draw up by-laws which would, as far as possible, meet the requirements of their respective towns. To go as far as Mr. Angell had suggested would be going a little too far for provincial places. As to fees for supervision, I think it would be difficult to carry out Mr. Angell's suggestion; but, if such fees were paid, the surveyor should have nothing whatever to do with them, but they should be paid direct to the Borough Accountant. If fees were imposed for the supervision of buildings, why not also for the formation of private roads? I do not believe the latter is generally done, though when the Corporation made the roads for owners, sometimes 5 per cent. is added to the cost for the supervision. How far should inspection of drains go? Should it be confined to drains out of doors, or should they insist on something more being shown on the plans deposited with the sanitary authority for approval? I do not think it is the practice with many Boards to require plans, apart from the building, showing what the builder is going to do with respect to the paramount question of drainage. That which is above ground they can control, but I think they should have something more shown them than at present about what is proposed to be buried. It is not sufficient merely to have a few lines drawn upon a plan, showing the direction of the pipes to be used, and, in some instances, the fall of the drain. Though it might appear to some going too far, I hold that they should also require a plan of the drainage, apart from the building, drawn to a scale of not less than 10 feet to an inch, giving longitu-

dinal sections of the main and every branch drain to the same scale as plan, horizontally and vertically, and showing the interior of the house as far as it is intended to drain anything within it. This has been done with great success in many towns on the Continent, where a special staff was kept for the passing of plans for the drainage of private houses and for the superintendence thereof during its execution, and where large numbers of contractors have, in consequence of such inspection, made a speciality of it. As to the cost of inspection, the gentleman who thought five inspectors would be required for West Ham might be right, if they went as far as the model bylaws extended; but at Leicester we have only two building inspectors. The town is divided into two portions, each with its own inspector. There are two inspectors of nuisances, who take the same districts as the building inspectors. What class of men should be engaged for supervising buildings? Should they be men capable of giving sound advice, and revising the plans laid before them, which large towns like Manchester, Liverpool, and Birmingham now have? and should not inspectors of nuisances be men capable of doing good sanitary work? If such men were provided, towns would no doubt be put to considerable expense; as they would require an increased staff, and of higher class men. But I am sure we shall all be agreed that this is what is wanted for large towns, where it is impossible for any individual surveyor to attempt the accomplishment of the detailed duties involved without such assistance. I should like the Association to take up the work of drawing up bylaws suitable for the towns the various Members represent, with an expression of opinion as to how they should be carried out, and the class and the number of inspectors who would be required properly to enforce the various provisions.

Mr. GAMBLE: The borough with which I am connected has enlarged its boundaries, and as it was decided that the bylaws of the incorporated portions should remain in force, I have therefore to carry out no less than four entirely different codes of bylaws. On trying to get uniform bylaws approved, the Local Government Board returned them, with a request that the model bylaws should be adopted. The latter contained a number of provisions which had no relation whatever to Grantham. After a correspondence extending over eighteen months, we have now a code proposed, with twelve new laws and various sub-sections. We tried hard to retain one provision in the old bylaws, regulating the height

of rooms, but were informed by the law-officers of the Crown that this was entirely beyond the scope of the Public Health Act. These bylaws will, in two or three months, become law, but I told the Corporation it would be almost impossible to get them carried out. It is stipulated 101 things are not to be done, which I am sure builders would do if the surveyor were not in the same room with them constantly. The difficulty will be, how to carry out such stringent bylaws where there is no adequate staff to see that they are properly observed. In my case, it is "Hobson's choice"—the present four codes, or else the model bylaws.

Mr. JONES: I do not agree with all that has been said, though I generally agree with Mr. Vawser if possible. I think many of the remarks which have been made are quite beside the mark. I do not see why a builder should not pay for what he gets; and the certificate that the house had been built under the supervision of a competent surveyor certainly augmented its value. No doubt, when he sold his house, the builder showed his certificate to the purchaser, and thus obtained more money for the property than he would have got without such a certificate. It was my lot once to have charge of a metropolitan district, and to my knowledge fees had there been paid by builders for many years. I cannot see, therefore, why there should be any difficulty as to the payment of fees under Local Boards. Why should they not be paid direct to the Board, through the ordinary routine of the office? I do not advocate the receipt of the fees by surveyors—that the Association has always opposed. Members of Local Boards generally objected to any increase of salary when it had to come out of the rates; but they could hardly object, when it was shown that 300*l.* or 400*l.* a year was being received in fees from buildings that were being erected, to provide sufficient assistance to enable the principal officer to properly enforce the bylaws. It was no use whatever adopting bylaws unless they could be carried out. After a long correspondence with the Local Government Board, we have at Ealing what I consider a fair code of bylaws, and I believe the Local Government Board are in favour of fees being paid by builders; and I therefore hope the day is not far distant when fees will be imposed to provide the necessary supervision for buildings whilst they are being erected. It is only in large towns that the cost of the necessary supervision can be provided out of the rates without being felt.

The PRESIDENT: It may be interesting to the Members of the

Association to know that, prior to 1851, there were no less than fifteen governing bodies in the borough; and there were no by-laws in Birmingham until 1876. When we applied for the amendment of our local Act in 1861, I asked to have such bylaws, but they were all erased by a stroke of the pen. In the meantime I did the best I could with the office staff to superintend the erection of buildings. I have now a building surveyor, who sees to all the work within the walls, with the exception of private drainage; and there are clerks of works, or inspectors, as required, for superintending drainage works. With respect to fees, I do not like the idea of receiving them, but still it is quite impossible to prevent a surveyor having to receive some money at his office. In my own office, 30,000*l.* or 40,000*l.* a year is received on account of private improvements. In the case of private improvements, 5 per cent. extra is always charged, to cover the cost of supervision, &c.

Mr. ANGELL, in replying, as the reader of the paper, first expressed his thanks to those who had taken part in the discussion for the way in which various points had been taken up. Mr. Vawser considered he had made out a strong case "for his peculiar views"; but he might rejoin that his views, with respect to fees, were general throughout the metropolis, at Bristol, and have recently been adopted in the town of Eastbourne. He had endeavoured to show that, as supervision was necessitated by builders working in their own interest, there was nothing "peculiar" in their being required to pay for it. Mr. Vawser suggested they should take into their own hands the putting in of all drainage. That would, in principle, be charging a fee; but they had not the slightest power to do what Mr. Vawser suggested. Work was to be done under the inspection of the surveyor, but he had no power to prevent any one entering a drain under proper supervision. It had been the practice at West Ham to require a plan, and then for the surveyor to have the work done by his own men; but, if there were any objection, he knew that the practice could not be legally enforced. He must differ from Mr. Vawser as to the class of men they required as assistants. They wanted such as were capable of looking over a plan, of knowing whether it was a proper plan—men at two or three guineas a week, who would be competent to act or give advice in particular cases. Mr. Ellice-Clark complained that he had not furnished details; his object was rather to discuss and enforce a principle. He agreed with Mr. Lemon that it should

rest with the responsible officer, and not with any committee, to take proceedings when any bylaw was broken. In all courtesy, it was ridiculous of Mr. Lynde to talk to the members of that Association as he had done as to assistance, because in the position he occupied at Manchester, where they had spent half a million on a Town Hall, he had only to ask and to have. Was he a fair sample of the Members of that Association, of the work which they had to do, and of the difficulties with which they had to contend? Mr. Lynde was entirely out of court. Mr. Lynde and Mr. Morant said they gave certificates on the completion of a building, but what legal power had they to do so?

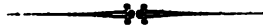
Mr. LYNDE: A private Act.

Mr. ANGELL: Lord Redesdale told them they must not have private Acts, and to give a certificate under existing bylaws was entirely *ultra vires*. If a code of bylaws containing this provision was now sent up to the Local Government Board, it was at once struck out. As to the objection to builders paying fees, he really could not understand it; as the President had said, a large amount of money already passes through the office. He (Mr. Angell) would have all the fees pass through the clerk's office. The Local Government Board, knowing the difficulties they had imposed on surveyors, were, he believed, practically in favour of the proposal, and had given the West Ham Board a letter, stating theirs was such an exceptional case that the power ought to be granted. He had endeavoured in this paper to raise the question; he knew local authorities generally would not employ the necessary inspectors, and was confident the experience of Mr. Lynde at Manchester was not the experience of the great majority of the Members of that Association.

On the proposition of Mr. MORANT, seconded by Mr. LYNDE, a vote of thanks was unanimously accorded to Mr. Angell for his paper.

ANNUAL MEETING AT BIRMINGHAM,

July 7, 8, and 9, 1881.



THE RIVERS CONSERVANCY AND FLOODS PREVENTION BILL.

By R. VAWSER, M. INST. C.E.

A BILL for the improvement of rivers and the prevention of floods having passed the House of Lords, and a Select Committee of the Commons having reported thereon, the present appears a favourable opportunity to direct the attention of the Association of Municipal Surveyors to the duties and obligations which sanitary authorities will incur if the Bill becomes law.

The Bill contemplates extensive engineering works for ameliorating the condition of flooded districts, and as sanitary authorities, and especially urban authorities, will have important duties to perform in directing and controlling the works that may have to be undertaken, the Members of this Association, in their capacity as engineering advisers to such authorities, are intimately concerned in the progress of the Bill and its leading provisions.

The Bill is based on the recommendations of a Select Committee of the House of Lords in the Session of 1877, and provides that any sanitary or conservancy authority, having jurisdiction within any part of a river basin, or contiguous river basins, also any twenty owners or occupiers of land of an aggregate rateable value of 2000*l.*, can initiate proceedings for the establishment of a Conservancy Board for the river basin or district in which they dwell, and the Local Government Board may thereupon appoint an inspector to view the district, hear evidence, and inquire generally into the expediency of constituting a Conservancy district, and as to the limits of such district, and likewise as to which parts of

such district shall be described or classified as lowlands, midlands, and uplands, it being provided that property differently classified shall contribute towards the expense in such different proportions as may appear equitable and as may be provided in the order; the lowland, which it may be presumed will derive the greatest benefit, being taxed at the highest rate. In constituting the Conservancy Board, provision must be made to secure the due and sufficient representation of owners and occupiers, having regard to the incidence of taxation under the Act, and, when circumstances require, for the representation likewise of sanitary or conservancy authorities, or other similar bodies.

The duties of a Conservancy Board to be appointed under the Act will include the cleansing, repair, and maintenance of all existing watercourses or outfalls for water, and of all walls, embankments or other defences against water; the deepening, embanking, or otherwise improving any watercourse, and altering or improving any mill-dam or similar obstruction; and the construction of any new watercourse, dam, or embankment. The powers conferred by the Act may, under certain conditions, be exercised beyond as well as within the district of the Conservancy Board, and two or more Conservancy Boards may combine for the execution of works.

The Conservancy Board may take proceedings against any person who is liable by tenure, custom, or prescription to do any act or thing included within the duties of the Board, for the purpose of enforcing such liability.

Each Conservancy Board must be established by Provisional Order, and the powers of the Act must not be exercised until such order has been confirmed by Parliament, after the manner of Provisional Orders under the Public Health Act.

The compensation to be paid to any person injuriously affected by the operation of the Act to be settled in the manner provided by the Lands Clauses Consolidation Acts.

When it was first proposed to introduce this subject to the meeting, the Bill now before the House of Commons had not attained its present stage of progress, and it was then the author's intention to point out the urgent necessity for further legislation to enable comprehensive schemes of River improvement to be undertaken, to prevent injury to health and destruction of property inseparable from the present system; but the necessity of legislation is acknowledged, and the principle of the Bill appears to meet with general approbation, and, as frequently happens, it incurs as

much danger from those who seek to make it compulsory and imperative as from opponents who would throw it out altogether. The author does not share the opinion of those who believe that a small interest unfavourable to any remedial measures can prevent necessary works being effected, as the powers proposed to be granted to the Local Government Board to group the various authorities, and in fact to fix the boundaries of the Conservancy district, constitute an ample guarantee that the objects of the Bill cannot be thwarted by a small minority. This provision will likewise prevent an injustice when any district free from floods is sought to be taxed for the benefit of the surrounding districts.

The proportion of expense which lowlands, midlands, and uplands respectively should bear is a fair subject for discussion. The Bill provides that the highest rate payable in the uplands shall not exceed one-tenth of the rate payable by the district which pays the highest general rate. It has been contended that as the uplands will derive no benefit, they should not bear any portion of the expense; on the other hand, it is urged that improved drainage in the uplands involves the more rapid discharge of surface-water and causes flooding in the lowlands. The author believes that the provision in the Bill limiting the liability of the uplands to a comparatively small share of the expense is a wise and fair arrangement, because excessive floods are not due exclusively to any act or fault either of owners in the lowlands or the uplands, and the encroachments and general deterioration in the lowlands, and the sudden efflux of water from the uplands, are in certain degrees the origin and cause of such floods. The expense and the depreciation in the value of property consequent upon increased rates is no valid argument against the policy of the Bill, even in districts where no direct advantage will be gained by improved outfall works, for the cost of the necessary works, although amounting to large sums in the aggregate, will be inappreciable if distributed over large areas. The Bill provides that where efficient works have already been executed in any district for the *common benefit*, the Conservancy Board shall take that fact into consideration, and may wholly or for a time exempt certain lands from conservancy rates, and any person feeling himself aggrieved by the decision of the Conservancy Board, shall have the right of appeal to the Local Government Board.

The Bill, as the President of the Local Government Board recently informed a deputation, is a general Bill to set up machinery

by which provision may be made to meet the requirements of each separate river basin or locality, and will not necessarily be applied in its entirety to parts of the country, or to conditions for which it is entirely unsuited; the Bill will empower the inhabitants of a river basin to obtain a Conservancy Board to regulate the whole course of the river, or to bring into common action the different authorities upon it. The President added "that those who propound a scheme will have to make out a good case for the whole river basin with which they are concerned."

It does not follow from this concluding passage that a Conservancy district would necessarily include the whole area of large river basins, such as the Mersey or Trent, and their tributaries, but only such portions of the main streams or such of their tributaries as by identity of interests, or local requirements, ought to be grouped together for Conservancy purposes; but as the usefulness and efficiency of a Conservancy Board will depend in a great measure upon the wealth, population, and importance of the district it represents, such district should, as a rule, include the whole of a river basin or watershed. The Bill provides that an urban authority in districts with a population not less than 25,000 *may* be constituted a Conservancy Board within its own districts, but the author believes that this provision cannot be extensively adopted without loss of efficiency; cases where local authorities can advantageously be entrusted with the powers of the Act are very rare, and it is not difficult to imagine that some authorities would evade the spirit by conforming to the letter of the Act if entrusted with its execution. Less objection can be urged against the proposal to establish sub-districts, and this is fully provided for in the Bill.

The anxiety of certain authorities to be exempted from the Act is difficult to understand, because the Act cannot be applied in any district until put in force by Provisional Order and confirmed by Parliament, and it is quite competent for any person to oppose the order; and if good cause can be shown at a local inquiry against the adoption of the Act, it will not be put in force. All works of sewerage and water supply are specially protected. So likewise are the works of railway or navigation companies, and all other works established or authorised by Act of Parliament. Special clauses are introduced into the Bill dealing with the drainage and conservancy rights in the fen districts, but these are not of general interest.

Notices have been given that when the Bill comes forward for further consideration in the House of Commons its rejection will be proposed, but upon what grounds does not appear. Notices of amendment have likewise been given. It is quite evident that in the present state of public business, an Act of this character cannot be passed to satisfy every interest and every shade of opinion, and some concession should be made to what appears the interest of the majority, and minor objections should not be pressed so as to endanger the whole Bill.

The Members of this Association necessarily have great experience in relation to flooding in towns, and the impossibility of effecting extensive remedial works without the co-operation of adjoining districts, or without the powers the Bill now before Parliament will confer; and the author submits that the Bill will prove a great boon in every part of the country, and has been prepared with due regard to existing and vested interests, and deserves the earnest support of all sanitary authorities.

DISCUSSION.

Mr. A. W. PARRY: Mr. Vawser speaks lightly of the wisdom of urban sanitary authorities seeking to be their own Conservancy Boards; it may be a matter of small importance to towns generally, but I think I can make out a case where it would be useful for an urban authority to become its own Conservancy Board. Compensation is to be made for all loss or injury sustained by any one by reason of the exercise of any of the powers contained in the Bill; and it should be well understood that such compensation may have to include the entire reconstruction of works. The alteration of the level of rivers and watercourses is certain to affect the water power to pumping machinery, and as the alterations which may be made are for the prevention of floods, Corporations are not in a position to say that they ought not to be done. Yet, when their water power is enfeebled, it is of the utmost importance to them to see that full compensation is given where new waterworks have been constructed, at a recent date, under Parliamentary powers. Another important feature is the drainage of land. Reading has purchased 767 acres of land for an irrigation farm, for the disposal of the town sewage. Part of that land has always been subject to floods; but at an expenditure of 40,000*l.*, under an Act passed eleven years ago, which empowered them to

lower the level and improve the channel of the River Kennet for about a mile in length, we have not only entirely freed the land from floods, but greatly increased the water power for waterworks pumping purposes, and have in consequence built new waterworks, at a further cost of about 13,500*l*. I therefore think it will be seen that, if full compensation were not granted to Reading should the present level of the River Kennet be interfered with, the town would suffer a heavy pecuniary loss. The imposition of a rate to pay for works that might be ordered by a Conservancy Board would be unjust, if the expenses already incurred were not fully taken into account. The Bill provides that urban sanitary authorities may be Conservancy Boards, but they should also be able to include within their district such adjoining areas as might be usefully added thereto. For example, at Reading, immediately abutting upon the borough boundary, are the sewage farm and waterworks already mentioned. It will also be seen that the Bill leaves the Thames Conservancy Board in full possession of its powers, which takes in nearly a mile in length of the River Kennet from the River Thames. About 380 yards of half the width is outside the borough, in which case, if the Reading Corporation, as an Urban Conservancy Board, were allowed to include within its district adjoining areas, it also ought to claim to incorporate into such district the area of the River Kennet now under the control of the Thames Conservancy Board, as well as certain other areas outside the borough. The pumping power for raising sewage, as well as for waterworks, and for feeding the settling tanks and waterworks filters is dependent upon the present falls obtained in the River Kennet—that for sewage pumping is in that part of the river under the Thames Conservancy Board; and for the waterworks, immediately outside the borough boundary. Should these falls be interfered with by any Conservancy Board, entirely new works would be necessary in the case of the waterworks, and the additional expense of constant steam pumping at the sewage station would also be entailed. These are to me sufficient reasons why Reading should be excluded from the operation of the proposed Rivers Conservancy Bill, or at any rate be constituted a Conservancy Board.

Mr. McKIE: This subject, viz. "A Bill for the Improvement of Rivers and Prevention of Floods," is one which I have had in my mind over twenty years. There can be no doubt that the principal cause of floods is, the owner on either side of the rivers having brought their embankments as near to the edges of the rivers as

possible. The consequence is that whenever a great flood comes down, it is forced to go over the land on one or both sides of the river. In some cases where I have been called upon to advise respecting floods, I have simply had to take away the embankment already made, and make another farther from the river, giving it sufficient water-way to discharge more than the greatest known flood, and this has frequently had to be done at the expense of one landowner because the owner on the opposite side of the river had placed his embankment close to the river. I am now engaged upon a river embankment two and a quarter miles long, where good arable land has to be sacrificed for this purpose. I should be pleased to see such an Act as that proposed, in operation, and fully agree with Mr. Vawser's remarks respecting it. Twenty-six years ago, when I first went to Carlisle, a considerable portion of the city was subject to flooding. We set to work, however, and made adequate river embankments, and since then they have never had a flood in the city.

Mr. ELLICE-CLARK: I think it would be objectionable to have so many boards—Sanitary Boards, School Boards, and Boards of Guardians—having jurisdiction over the same areas. The Bill will probably soon be massacred, with other Parliamentary innocents, and it would be well if the Legislature wait till it can deal with the whole question of County Boards, which must come soon. County Boards could deal with this subject of floods better, and that is one reason why so many objections have been raised to the present Bill. A great deal depends upon the class of persons who are appointed on such a Board. Flood Prevention Acts have been passed as far back as the time of Henry VII., but, as the Board consisted principally of farmers, very little was done. It would be far better to leave this matter to County Boards than to go on multiplying different kinds of Boards all over the country.

Mr. LEMON: Many floods are caused by rivers which are the division between two counties. I therefore do not see how County Boards could effectually prevent floods unless power were given them to unite in certain cases for that purpose. It is desirable such a Bill as that before Parliament should be passed. I know several cases where serious results have ensued, which would have been prevented by such a measure. I do not, however, quite agree with the way in which it is proposed that the charges should be levied. A great portion of the expense is to be thrown on the low-lying district. It is quite true the low-lying district would

derive great benefit, and that the floods frequently arise from the encroachment of landowners; but it is also true that low-lying land is often flooded from the want of proper diversion of water from the high lands. It is quite clear the high lands could not be drained except by the river, and consequently the high lands within the watershed which contribute to the river should contribute likewise to the cost of preventing floods. Owners who contribute to floods, should also contribute to prevent floods. In draining a town they endeavoured to get rid of water from the high-level district, so as to relieve the low-level; and with respect to floods, I consider the high-level district should contribute towards remedying the nuisance they helped to create. It is a very good Bill in principle, and I hope that it will pass during the present session.

Mr. LOBLEY: I think there is not sufficient distinction made in the Bill between town and country. No doubt rainfall runs from the streets and houses quicker than when the town was arable land, but to charge the rate upon the high rateable value of property in towns would be very unfair indeed. Besides, in an urban district, land, whether the general district-rate or poor-rate was adopted, would only be assessed at one-fourth of its rateable value, whereas that outside an urban district would contribute upon its full rateable value. This, I think, should be remedied. I do not think County Boards would at all meet what was required. In the Birmingham, Rea and District Drainage Board there were at least three different counties concerned.

The PRESIDENT: I can give another illustration of the necessity for Conservancy Boards. The borough of Birmingham is bounded on its northern side by the Aston Brook, which separates it from Aston Manor, a very populous suburb. The owners of property, wherever they could, had built into the watercourse, and had left only a very limited space for the flow of the water. Through the deposition of brick ends and other rubbish, it is no exaggeration to say that the bed of the brook was three or four feet above its natural level. The Local Board of Aston and the Corporation of Birmingham thought that about two miles and a half of this brook should be cleansed and deepened, which meant the underpinning of houses and the re-erection of bridges. We applied to the Local Government Board for its sanction to borrow the requisite money, but their reply was that the Board had no power to sanction such a loan. The only way we could get the money was, that I

had to go before the county magistrates of Warwick, and swear how bad the brook was in the borough of Birmingham. Then I had to reverse the proceedings, and swear before the borough justices how bad the brook was in the county of Warwick. We then obtained the magistrates' order, and some 22,000*l.* has been expended in widening and deepening the brook. Even now there is some difficulty in the way of the Aston Board paying their share of the extra cost. Another stream, running alongside the borough, and through an urban portion thereof, is the River Rea, which is silted up and obstructed to such an extent as, in my opinion, to endanger some of the bridges. There is to be a meeting of the three outside authorities next week to see whether any arrangement can be made for carrying out this work; but, even if they agree upon what should be done, I do not know how the money is to be raised. I therefore think some measure like the Conservancy Bill is needed, to enable such difficulties as I have mentioned to be overcome.

Mr. VAWSER, in the course of his reply, the discussion having been closed, said he thought Mr. Parry's remarks proved in the most complete manner that Reading should come under the Bill, and be represented on the Local Conservancy Board. He did not anticipate that inconvenience would arise by increasing the number of local authorities; there need be no confusion, as the duties and powers of the Conservancy Board were well defined, and would not clash in any way with those of other Boards to which allusion had been made. Then, with respect to the expenses, towns suffered quite as much from floods as rural districts, and were quite as deeply interested in an effectual remedy being devised; Manchester, Nottingham, Leicester, and many other towns in the Midlands, all suffered from floods, and he was informed on the best authority that the cost of works necessary to prevent such floods would not exceed 2*s.* 6*d.* per house per annum. He was very much pleased with the discussion which had taken place. He had not attempted to establish a new theory, but only to discuss a matter highly interesting to them all, and he thought they should sometimes discuss matters of general interest, even though they did not immediately fall within the scope of their official duties.

Mr. PARRY: At Reading we have had some experience of one Conservancy Board. We found they were a very difficult body to deal with, as they spent most of their money in the neighbourhood of London. I am not opposed to the Bill, but simply

contend that, unless special provisions are made to protect the interests of Reading, it should be excluded from coming under the action of the Bill. There is an obstruction to the river at Reading in that part under the control of the Thames Conservancy Board, known as Silly Bridge, but we cannot get this removed.

On the proposition of the PRESIDENT, seconded by Mr. ELLICE-CLARK, a vote of thanks was tendered to Mr. Vawser for his paper.

ANNUAL MEETING AT BIRMINGHAM,

July 7, 8, and 9, 1881.

STEAM ROAD ROLLING.

By E. BUCKHAM, Assoc. M.I.C.E.

THE author has the pleasure of submitting to the Association the accompanying information on steam road rolling. Vide Tables, pp. 141-144.

The answers and opinions given by thirty towns that were communicated with, where these machines are in use, vary considerably, but in every case steam rolling is recommended as being in every way better and more economical than horse rolling. The reason of this (to those having had experience of both) is obvious. With a horse roller there is always a certain displacement going on by the action of the horses' feet, and although the stones disturbed in this way are all eventually consolidated by the roller, it destroys the evenness of the surface. With a steam roller there is no displacement, hence a perfectly even surface. Their use is more particularly applicable to roads repaired with granites and other equally hard stones; with our local pit stone (gravel flints) the gain would not be the same, because they do not possess the power like stones of angular form of interlocking under heavy pressure.

The advantages of steam rolling over horse are—

1. Economy.
2. Facilities of perfect construction.
3. Less inconvenience to the public, by the roads being repaired more expeditiously.
4. Comfort to persons travelling.

5. Greater consolidating power than would be possible with a horse roller.

6. That roads can be made equally well at all seasons of the year.

Then there is the indirect saving caused by the improved road surface, which, of course, must diminish the wear and tear on horses and vehicles.

The printed replies will speak for themselves, but I should like to direct attention to a few of the most important points respecting them. With a few exceptions, no definite figures are given of the saving of steam rolling over horse rolling. In many towns no record showing the comparison has been kept; but at Birmingham it is put at two-thirds the cost of horse rolling, at Bristol one-half. From Islington the reply is, "That you cannot compare the two, for the reason that steam rolling is altogether so vastly superior to horse rolling." At Leeds 25 per cent. is given as the saving. At Marylebone the difference between $4\frac{1}{2}$ tons horse, and 15 tons steam roller is given at 1.6 farthings per square yard for the former and 2.0 for the latter. At Merthyr Tydvil it is given at one-third of horse rolling.

Every town returns Messrs. Aveling and Porter as the makers of their steam rollers. These in most instances are of an old pattern; great improvements have since been made by Messrs. Aveling and Porter in their machines. For instance, they are now driven and steered by one man, the gear is of steel instead of cast iron, the shafts and axle are of steel, they have fast and slow speed instead of one speed, &c.

The replies in answer to the question as to whether "steam-rolled roads are more durable than those made by the ordinary traffic" are, with two exceptions, in favour of the former, and some surveyors state that there is no comparison between them. The Surveyor of Birmingham, however, states that "they are generally considered so, but are certainly not more durable." The city engineer of Norwich states, "No, I think not. The best roads are made by the action of the traffic." In reply to the question, "Would you advise the adoption of a steam or horse roller in a town where the main streets are narrow, with considerable traffic?" the answers are all in favour of steam. I omitted in my queries to ask whether much damage had been done to gas or water mains, but have since written to several towns for information, and, with

the exception of Brighton, there has been no accident of any consequence. I believe with a 10-ton roller, with the weight equally distributed on three wheels, there would not be much probability of accidents of this kind, and in this opinion I am supported by the surveyors of other towns.

On the first day of the Meeting the Members visited the Sewage Farm at Salfley, under the courteous direction of Mr. Alderman Avery (Chairman of the Birmingham, Tame, and Rea District Drainage Board), and the Intercepting Works at Montague Street, where the various operations of the pail system were ably described in detail by Mr. Councillor Martineau. In the evening the Members dined together at the Queen's Hotel.

On the third day the Members first visited the Gasworks, the various departments of which were explained by the engineer, Mr. Hatch; and then proceeded to the Waterworks, where Mr. Gray, the engineer, acted as guide.

Votes of thanks were in each case very cordially passed to the several gentlemen who pointed out the features of interest at the various works visited.

| | General Remarks. |
|--|---|
| 15-ton 10 ton few | |
| Repair few | A piece of road made with the Steam Roller 2½ years ago at the bottom of the Preston New Road has not yet been repaired, and is yet good for several years' wear. The traffic over it is fast, such as tradesmen's carts, private carriages, cabs, &c., principally. Another road (Branch Road) almost on a dead level and made with common limestone lasted 2 years 3 months. These roads formerly had to be repaired twice a year, and were always objectionable from loose stones. |
| The 13 in | I am of opinion that if you wish good roads, <i>buy a Steam Roller</i> , and save the ratepayers' money. Also you will find it useful in picking up the roadways. |
| We acc | Our Roller has been found too heavy, especially for the steep roads in this district; but on tolerably level roads it has done its work remarkably well. |
| About paid for a yard; by a gas Steam Roller. 01. | A Steam Roller is a source of great anxiety. It is necessary to shut off other traffic when at work, and great care is required in dealing with Gas and Water Companies, especially where pipes are laid over sewer trenches or the like. |
| 51, t on con th | <p>PAVING.—We have about 15 miles paved streets and 10 of macadam roads. We generally roll the boulder down of a new street before it is paved: it sets and makes a good foundation. We use two sorts of stone on our roads, Welsh granite and common limestone. Ordinary limestone rolled makes a splendid road, but soon wears away unless carefully kept in repair. Welsh granite lasts much longer, but is not as good a road, the metal is always springing up in dry weather and frost. If you get a roller do not get one of more than 10 tons: ours is too heavy.</p> |

hes, that a great saving in
all other considerations of
gle accident has occurred.

when large quantities of
tage to pass a roller over
ear and wear of ordinary

hough I wavered at first in
glad I obtained one.

ing far superior to Horse

ir road; never put broken
tion No. 4, the Rollers now
ving 4s. 2d. per day. As
ed, roll, and roll by steam.
eat saving by so doing, the
air.

y on stones without having

| An | General Remarks. |
|---|---|
| <p>The av exper roller &c., on fi and drive sweet amov</p> <p>92. pe four</p> | |
| <p>10. to</p> | <p>Steam-rolled roads are more compact, smoother, cleaner, more durable, and in all respects infinitely better than unrolled roads.</p> |
| <p>About</p> | <p>In my opinion Steam Rolling is far superior to Horse Rolling, or leaving the streets in their rough state after being coated. I may say that in addition to rolling the streets our Steam Roller is used for driving hay-chopping and oat-crushing machines, and also for driving one of Blake's patent stone-breaking machines.</p> |
| <p>Varies</p> | <p>Where much broken granite is used, the Roller is essential for comfort; but for wear a road, that is formed by its own traffic is the best. We never use it except in the centre of the city.</p> |
| <p>Being</p> | |
| <p>15.</p> | <p>The roads are rolled more evenly, it is more expeditious and much better for public and narrow thoroughfares. The turning of a Horse Roller every time forms an indentation in the road, which if not properly attended to at the time will cause the road to be very uneven on the surface in places.</p> |
| <p>36. coul bee</p> | <p>It is of importance to consider whether there is sufficient work for a Steam Roller. In towns like Salford, which are for the most part paved, there is not sufficient work to justify its employment, but a certain amount of income is derived from letting it to Local Authorities whose roads are not paved.</p> |

your district, I think, the Com-
team Roller. They are made
at much less cost than those

gth of macadam roads, it is of
r, or the cost of repairing the
excessive. If no roller is used,
ese hold water and spoil the
talling is very cruel and un-

out 20 per cent. of rolled over

and certainly no town where
airs must be frequent. You
r new metal without a Roller;
o do so with constant attention
er you may allow the heaviest
s made, and you will have no
. I have two or three streets
over which pass waggons with
to 4 tons of iron, and I never
thoroughly.

Memoirs of Deceased Members.

The Council, having been requested to append some short notice of the decease of Members of the Association, will feel obliged by early notice being forwarded to the Secretary, with such particulars as it may be desirable to insert in these 'Proceedings.'

The Council regret much to have to chronicle the death of several members ; and foremost among these stands the name of our respected ex-president Mr. Alfred William Morant, M. Inst. C.E., F.S.A., F.G.S., who only a few days since (July 7, 8, and 9) was present with us at Birmingham, there finishing his presidential year. Mr. Morant, who was in failing health at the time we refer to, returned to his home at Leeds, and in the course of a few days passed away. The following extract, which we take from the *Leeds Mercury*, of July 29, 1881, gives a concise account of Mr. Morant's public life, and we can only add to it that we lose in Mr. Morant a sincere friend to the Association, and one who, by the general kindness of his manner, had gathered to himself the respect and esteem of all who knew him.

" We regret to announce the death of Mr. Alfred William Morant, engineer to the Leeds Corporation, which took place at his residence, Virginia Road, Leeds, at one o'clock yesterday morning. The deceased gentleman, who was 53 years of age, had been in failing health for some time, but it was not until a fortnight ago that the symptoms, which were of a complicated character, became serious. His case became worse a day or two ago, and he eventually succumbed to the illness as stated. The deceased gentleman was well known and highly respected in Leeds, not only on account of his official position, but his private worth and intellectual attainments. He was born in the south of England, and his early life was spent in London. He first officiated in the capacity of borough surveyor at Great Yarmouth, and then removed to Norwich, where his

ability as a sanitary engineer, in the construction of the Norwich Drainage Works, was manifested. He was appointed borough engineer of Leeds in December 1872, in the place of Mr. Fowler, who is at present borough surveyor at Newcastle-on-Tyne. Since his appointment he has had an intimate connection with engineering and scientific movements, which for him had an absorbing interest. In his capacity as the Leeds borough engineer, he carried out the Leeds sewage works at Knostrop to their present state of completeness, designed and carried out the extension of the Kirkgate market and the fish market, the improvement of York Street, the widening of Wellington Bridge, the laying out of roads in Roundhay Park; designed and constructed the large extension of the sewerage system of Leeds for the out-districts, the connection of Armley with Kirkstall by bridges and viaducts across the River Aire and the Leeds and Liverpool Canal; and introduced in Leeds the present system of the ventilation of sewers through gullies, referring to which a few days ago at Exeter, Mr. R. Rawlinson, C.B., chief engineer to the Local Government Board, stated that the Leeds sewers were the best ventilated in England. Mr. Morant, who was a Fellow of the Society of Antiquaries, a Fellow of the Geological Society, and a member of the Institute of Civil Engineers, was a gentleman of considerable literary ability and archaeological attainments. He recently edited an alphabetical dictionary of coats-of-arms belonging to the families of Great Britain and Ireland, which formed an extensive ordinary of British armorials upon an entirely new plan by the late Mr. Jno. W. Papworth, F.R.I.B.A., one of Mr. Morant's cousins. Mr. Morant also possessed the MS. of a similar undertaking upon foreign heraldry. The deceased gentleman was President of the Association of Municipal and Sanitary Engineers for 1880-81, which body, it will be remembered, visited Leeds recently, and on which occasion he delivered a most able address on sanitary science, with reference to the departments connected with the Leeds Corporation. For one year he was Vice-President of the Leeds Architectural Association. He edited the latest edition of Whitaker's Craven, and also the latest edition of Dodgson's Guide to Leeds; whilst during the whole of his official career he occasionally read papers on architectural, archaeological, and engineering subjects before various scientific societies, besides contributing papers on "Indications of Date" to the *Architect*, which were subsequently published in pamphlet form. Mr. Morant leaves a widow and three sons and five daughters."

Mr. Edward Loney Stephens died at his residence, Hinkley Road, Leicester, on June 2nd, 1880, in the 64th year of his age.

He was the eldest son of Captain E. L. Stephens, R.N., of West Cowes, Isle of Wight, and had held the office of Borough Surveyor for upwards of twenty-seven years, and was well known in connection with the numerous engineering and architectural works and street improvements undertaken by the Corporation during that period.

Among the chief works carried out by Mr. Stephens were the following, viz. the Borough Gaol Extension, costing 16,000*l.*; the New Bow Bridge, costing 1000*l.*; the North Bridge, costing 5000*l.*; the Borough Lunatic Asylum, costing about 60,000*l.* He also prepared schemes for very important town improvements, and, in conjunction with Mr. Hawksley, prepared plans, &c., for lowering and improving that part of the River Soar within the borough of Leicester. These works were embodied in different Acts of Parliament, of which he had charge; portions of these works are now in progress.

Mr. E. L. Stephens was one of the first members of our Council, and one of the few gentlemen who met together in the first instance to promote the formation of this Association.

The remaining deaths are Mr. J. Craggs, of Shildon and East Thickley, in whom the Association has lost one of its most zealous members, and Mr. J. Galsworthy, of Aldershot, who died on the 25th of June, 1880.

CHAS. JONES, *Hon. Sec.*

THOMAS COLE, *Secretary.*

PROCEEDINGS
OF
THE ASSOCIATION OF MUNICIPAL AND SANITARY
ENGINEERS AND SURVEYORS.

CONTENTS OF VOLUME VI.

PAPERS AND DISCUSSIONS:

- SLUICES AND PENSTOCKS.—H. O. SMITH.
ELECTRIC LIGHTING, AND ITS APPLICATION BY MUNICIPAL
AND OTHER BODIES.—J. N. SHOOLBRED.
REPORT OF THE SELECT COMMITTEE OF THE HOUSE OF
COMMONS UPON LIGHTING BY ELECTRICITY, JUNE 13,
1879.
SEPARATE SYSTEM OF TOWN DRAINAGE.—L. ANGELL.
ASPHALTE, AND ITS APPLICATION TO STREET PAVING.—E. B.
ELLJOR-CLARK.
ROCK-CONCRETE TUBES: THEIR MANUFACTURE AND USE.—
C. FLETCHER WOODS.
THE MANUFACTURE AND APPLICATION OF SILICATED STONE
FOR SEWER TUBES.—J. W. BUTLER.
THE DEVELOPMENT OF THE MANUFACTURE OF STONEWARE
FOR SANITARY AND ART PURPOSES.—HENRY DOULTON.
JUNCTION BLOCKS, AND THEIR ADVANTAGES IN PIPE SEWERS.
—J. CRAGGS.
THE SEWERAGE WORKS FOR THE CROYDON RURAL SANITARY
AUTHORITY.—W. SANTO CRIMP.
NOTES ON IRONWORK.—O. GRAHAM SMITH.
SEWAGE DISPOSAL AT WEST DERBY.—E. H. ALLIES.
THE SANITARY CONDITION OF DEWSBURY AND ITS SEWERAGE
WORKS.—BEN. C. CROSS.
TOWN SEWERS.—T. HEWSON.
THE SEPARATE SYSTEM, AND THE ECONOMICAL DRAINAGE OF
TOWNS.—R. VAWBER.
THE HIGHWAYS AND LOCOMOTIVES (AMENDMENT) ACT, 1878.—
J. LOBLEY.
THE EFFECT OF SULPHATES ON LIME MORTAR.—C. GRAHAM
SMITH.
SEWER VENTILATION.—W. BATTEN.

Price 10s. 6d.

London: E. & F. N. Spon, 16 Charing Cross.
New York: 446 Broome Street.



